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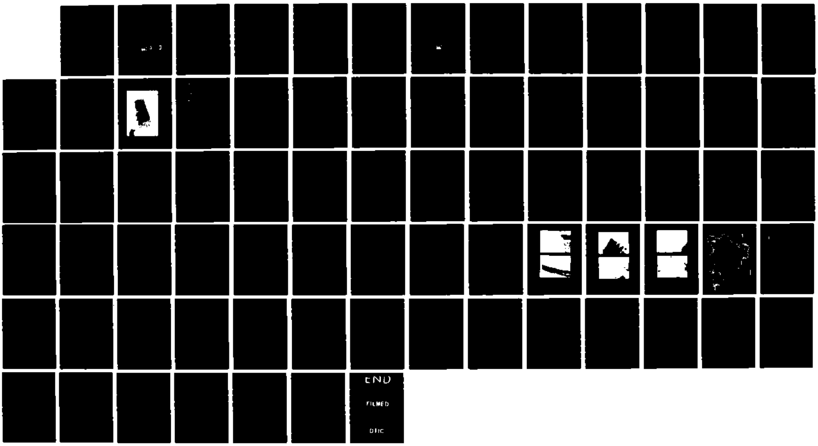

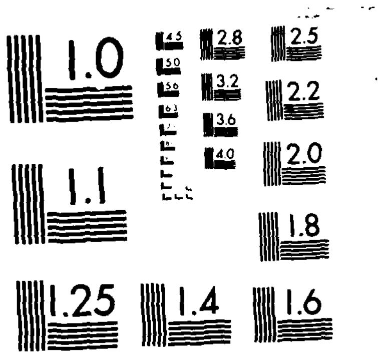


MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

NARRAGANSETT BAY BASIN
WEST WARWICK, RHODE ISLAND

# ARCTIC DAM
# RI 03802

## PHASE I INSPECTION REPORT
## NATIONAL DAM INSPECTION PROGRAM



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS. 02154



JANUARY 1981

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Cover program reads: Phase I Inspection Report, National Dam Inspection Program; however, the official title of the program is: National Program for Inspection of Non-Federal Dams; use cover date for date of report.

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

DAMS, INSPECTION, DAM SAFETY,
Narragansett Bay Basin
West Warwick Rhode Island
South Branch Pawtuxet River

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

The dam is 30 ft. high with a total length of 174 ft. long. It is small in size with a high hazard potential. The dam is considered to be in fair condition. No evidence of instability of the project was observed. There are items which require repair and/or maintenance.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02254

REPLY TO
ATTENTION OF:
NEDED

JUL 07 1981

Honorable J. Joseph Garrahy
Governor of the State of Rhode Island
State House
Providence, Rhode Island 02903

Dear Governor Garrahy:

Inclosed is a copy of the Arctic Dam (RI-03802) Phase I Inspection Report, prepared under the National Program for Inspection of Non-Federal Dams. This report is based upon a visual inspection, a review of past performance, and a preliminary hydrological analysis.

The preliminary hydrologic analysis indicates that the spillway capacity for the Arctic Dam would likely be exceeded by floods greater than 13 percent of the Probable Maximum Flood (PMF). Our screening criteria specifies that a dam classified as high hazard with a spillway capacity insufficient to discharge fifty percent of the PMF be judged as having a seriously inadequate spillway. As a result this dam is assessed as unafe, non-emergency until more detailed studies prove otherwise or corrective measures are completed.

The term "unsafe" applied to a dam because of an inadequate spillway does not indicate the same degree of emergency as it would if applied because of structural deficiency. It does indicate, however, that a severe storm may cause overtopping and possible failure of the dam, with significant damage and potential loss of life downstream.

We recommend that within twelve months from the date of this report the owner of the dam engage the services of a qualified registered engineer to determine further the potential of overtopping the dam and the need for and the means to increase project discharge capacity. Based on this determination, appropriate remedial mitigating measures should be designed and completed within 24 months of this date of notification. In the interim a detailed emergency operation plan and warning system should be promptly developed and round-the-clock surveillance be provided during periods of heavy precipitation or high project discharge.

JUL 07 1981

NEDED
Honorable J. Joseph Garrahy

I approve the report and support the findings and recommendations described in Section 7, with qualifications as noted above. I request that you keep me informed of the actions taken to implement these recommendations since this follow-up is an important part of the program.

Copies of this report have been forwarded to the Department of Environmental Management and to the owner, Arctic Development Corporation, West Warwick, RI. Copies will be available to the public in thirty days.

I wish to thank you and the Department of Environmental Managment for your cooperation in this program.

Sincerely,

C. E. Edgar III

C. E. EDGAR, III
Colonel, Corps of Engineers
Commander and Division Engineer

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NARRAGANSETT BAY BASIN

WEST WARWICK, RHODE ISLAND

# ARCTIC DAM

# RI 03802

## PHASE I INSPECTION REPORT

## NATIONAL DAM INSPECTION PROGRAM

DEPARTMENT OF THE ARMY

NEW ENGLAND DIVISION, CORPS OF ENGINEERS

WALTHAM, MASS. 02154

JANUARY 1981

BRIEF ASSESSMENT

PHASE 1 INSPECTION REPORT

NATIONAL PROGRAM OF INSPECTION OF DAMS

| | |
|---|---|
| Name of Dam: | ARCTIC DAM |
| Inventory Number: | RI 03802 |
| State: | RHODE ISLAND |
| County: | KENT |
| Town: | WEST WARWICK |
| Stream: | SOUTH BRANCH PAWTUXET RIVER |
| Owner: | ARCTIC DEVELOPMENT CORPORATION |
| Date of Inspection: | OCTOBER 8, 1980 |
| Inspection Team: | PETER HEYNEN, P.E. |
| | HECTOR MORENO, P.E. |
| | THEODORE STEVENS |
| | FRANK SEGALINE |

Arctic Dam was built around 1885 to generate electricity, but is not presently used for this purpose. The 30 foot high dam has a total length of 174 feet, consisting of a 110 foot long stone masonry spillway centered between two stone masonry and earthfill non-overflow sections. The top of the right non-overflow section is approximately 0.4 foot higher than the top of the left non-overflow section and 5.7 feet above the masonry spillway crest. Permanent stop planks, two feet in height, are mounted on the spillway crest. The low-level outlet for the dam is a 48 inch diameter steel pipe through the left non-overflow section. There are factory buildings adjacent to each end of the dam and masonry walls lining the downstream channel.

In accordance with Army Corps of Engineers' Guidelines, Arctic Dam is classified as a small size, high hazard dam. The test flood range to be considered is from one-half to full Probable Maximum Flood (PMF). The test flood for Arctic Dam is equivalent to the 1/2 PMF. Peak inflow to the impoundment at test flood is 16,500 cubic feet per second (cfs); peak outflow is 16,500 cfs with the dam overtopped by 7.6 feet. The spillway capacity above the permanent stop planks with the reservoir level to the top of the dam is 2200 cfs, which is equivalent to 13% of the routed test flood outflow.

Based upon the visual inspection at the site and past performance, the project is in fair condition. No evidence of instability of the project was observed.

There are items which require repair and/or maintenance, such as the deteriorated low-level outlet, gate, and gate hoisting mechanism, leached out mortar joints on the downstream face of the left non-overflow section, undermining of the wall on the right side of the downstream channel, and brush, saplings and trees growing on the dam and appurtenances.

It is recommended that the owner retain the services of a registered professional engineer to perform a more detailed hydraulic/hydrologic analysis of the existing project discharge capacity. Other items of importance are the restoration of the low-level outlet facilities, repair of leached mortar joints, repair of the undermined channel wall, and removal of trees from the dam and appurtenances.

The above recommendations and further remedial measures presented in Section 7.3 should be implemented within one year of the owner's receipt of this report.

Peter M. Heynen, P.E.
Project Manager - Geotechnical
Cahn Engineers, Inc.

C. Michael Horton, P.E.
Chief Engineer
Cahn Engineers, Inc.

This Phase I Inspection Report on Arctic Dam (RI-03802) has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgement and practice, and is hereby submitted for approval.

Carney M. Terzian

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

Joe Finegan

JOSEPH W. FINEGAN, JR., MEMBER
Water Control Branch
Engineering Division

Aramast Mahtesian

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

Joe B. Fryar

JOE B. FRYAR
Chief, Engineering Division

# PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspection. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I Investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam would necessarily represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions will be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established guidelines, the Spillway Test Flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

The information contained in this report is based on the limited investigation described above and is not warranted to indicate the actual condition of the dam. The integrity of the dam can only be determined by a means of a monitoring program and/or a detailed physical investigation. The accuracy of available data is assumed where not in obvious conflict with facts observable during the visual inspection.

TABLE OF CONTENTS

ace. Other than the old bridge pier, from which several small rees are growing, there are no obstructions in the spillway pproach channel. At the time of inspection, there was an accumu- ation of debris at the crest of the stop planks, 3 logs resting on he downstream face of the spillway, and various floating objects ollected on the rocks at the toe of the spillway (Overview Photo, hoto 3).

c. Appurtenant Structures - The operability of the low-level utlet gate for the dam is questionable and the 48 inch steel low- evel outlet pipe appears to be in poor condition. The control echanism, a rack-with-pinion gate hoist mounted on the upstream all of the left non-overflow section, is rusted and the wood gate upport is rotting (Photo 4). The handle for the control mechanism s not in place and the owner is not sure of its location. pproximately 200 gallons per minute (gpm) or more were flowing rom the downstream end of the low-level outlet pipe (Photo 2), ndicating that either the gate leaks or that it is not tightly losed, or possibly that there is seepage from the body of the dam nto the pipe. Observed from its downstream end, the pipe is in oor condition. Although it protrudes approximately 5 feet out rom the downstream face of the dam, extensive corrosion of the ottom of the pipe allows some of the flow through the pipe to be ischarged onto the masonry face of the dam, causing leaching of he mortar. Also, as previously mentioned, there is a clump of mall trees growing on top of the pipe at its point of exit from the am.

The factory buildings at each end of the dam appear to be in ood condition, with no notable signs of deterioration. The old ailrace channel under the factory to the right of the dam is filled n and now serves as a parking area. There were no observable roblems in this area.

d. Reservoir Area - The reservoir has steep-sided, wooded anks and the land at the top of the banks is heavily developed.

e. Downstream Channel - The downstream channel is broad and leep, although the normal flow is shallow. The channel bottom is ouldery and the channel sides are masonry walls for about 100 feet o the bridge. Brush and small trees are growing from the benches of the walls on either side of the river and it appears that the ight side wall is being undermined (Photos 5 and 6). The concrete rch bridge appears to be in good condition and does not appear to onstrict the river channel.

.2 EVALUATION

Based upon the visual inspection, the project is in fair condition. The manner in which the features identified in Section .. could affect the future condition and/or stability of the roject is as follows.

1. The root systems of the small trees on the left non- overflow section could provide paths for seepage through the dam, especially if they are allowed to grow to be large

## ...ION 3: VISUAL INSPECTION

### ...NDINGS

a. General - The general condition of the project is fai... ...inspection revealed several areas in need of maintenance. At ... time of inspection the upstream water level was at elevation ...2+, with approximately 2 inches of wat[illegible] flowing over the stop ...nks and masonry spillway.

b. Dam

Top of Dam - The top of the right non-overflow section is ... good condition, with a regular surface and good grass cover ...oto 1). A wooden railing on top of the masonry wall and ex...nding from the upstream edge of the dam to the bridge 100 feet ...wnstream of the dam is in fair condition, with slight rotting of ...e wood.

The top of the left non-overflow section is in poor ...ndition with a dense growth of small trees, saplings and under...ush and several footpaths due to trespassing (Overview Photo).

Upstream Face - The upstream faces of both the right and ...ft non-overflow sections are in good condition with no displace...nt of masonry and only minor leaching and cracking of the mortar ...nts.

Downstream Face - The downstream face of the right non-...erflow section is in go[illegible]d condition. No leaching or cracking of ...rtar joints or displacement of masonry was observed.

The downstream face of the left section is in poor ...ndition. In the area beneath the low-level outlet pipe, mortar ...s been almost totally leached out of the joints in the masonry ...hoto 2). This appears to be caused by leakage from the pipe onto ...e outside of the wall, rather than by seepage from the body of the ...m through the wall. A [illegible] of small trees, the roots of which ...y extend through the mason[illegible] [illegible] the body of the dam, is ...[illegible] on top of the outlet pip[illegible] [illegible] exits from the dam. ...er than in the area of the outl[illegible] [illegible] downstream face ...[illegible] to be in good condition, [illegible] is obscured by ...[illegible] and debris.

[illegible] - [illegible] to be [illegible] condition, ... the spillway prevented close inspection [illegible] downstream ... and toe. No irregularities of the tiered downstream face were ... and the abutments with the non-overflow sections appeared ...d, except for some leaching of mortar due to contact with wat... ... over the spillway. The masonry spillway crest appears [illegible] ...od condition, but the stop planks are somewhat leaky [illegible] ...[illegible]rated. The stop plank supports, though rusted on ...side, do not show any significant deterioration. Also, a... ...proximately 4 feet apart, they are closely spaced, and all are in

## SECTION 2: ENGINEERING DATA

### 2.1 DESIGN DATA

The available data consists of inventory data by the State of Rhode Island and inspection reports dated March 27, 1946 and September 11, 1978 by the State of Rhode Island (See Appendix B).

### 2.2 CONSTRUCTION DATA

No information is available.

### 2.3 OPERATIONS DATA

According to the 1946 inspection report a river gage was read every hour daily from 7 A.M. to 11 P.M. These records were not available.

### 2.4 EVALUATION OF DATA

a. Availability - Available data was provided by the State of Rhode Island and the owner. The owner made the project available for visual inspection.

b. Adequacy - The limited amount of detailed engineering data available was generally inadequate to perform an in-depth assessment of the dam, therefore, the final assessment of this dam must be based primarily on visual inspection, performance history, hydraulic computations of spillway capacity and hydrologic estimates.

c. Validity - A comparison of record data and visual observations reveals no significant discrepancies in the record data.

j. Regulating Outlets

Low-level outlet

| | |
|---|---|
| 1. Invert | 93.8± |
| 2. Size: | 48 inch diameter |
| 3. Description: | Steel pipe |
| 4. Control mechanism: | Rack with pinion gate hoist |
| 5. Other: | Operability questionable Location of handle unknown |

| | |
|---|---|
| 5. Test flood pool: | 28± acres |

g. Dam

| | |
|---|---|
| 1. Type: | Stone masonry gravity and earthfill |
| 2. Length: | 174 ft. |
| 3. Height: | 30 ft. |
| 4. Top width: | 70± ft. |
| 5. Side slopes: | Vertical |
| 6. Zoning: | Upstream and downstream masonry walls with center earthfill |
| 7. Impervious core: | N/A |
| 8. Cutoff: | Not known |
| 9. Grout curtain: | N/A |
| 10. Other: | Adjacent factory buildings close overflow profile |

h. Diversion and Regulating Tunnel - N/A

i. Spillway

| | |
|---|---|
| 1. Type: | Broad-crested masonry weir with 2 feet high permanent stop planks |
| 2. Length of weir: | 110 ft. |
| 3. Crest elevation: | 108.0-top of stop planks<br>106.0-masonry crest |
| 4. Gates: | N/A |
| 5. Upstream channel: | Shallow, gravel bottom |
| 6. Downstream channel: | Bouldery river bed with masonry retaining walls |
| 7. General: | Tiered downstream face. Bridge pier in approach channel |

3. Maximum tailwater: Not known

4. Normal pool: 108.0

5. Full flood control pool: N/A

6. Spillway crest (ungated)

   Top of stop planks: 108.0 (assumed datum)
   Masonry crest: 106.0

7. Design surcharge (original design): Not known

8. Top of dam: 111.3±

9. Test flood surcharge: 118.9

d. <u>Reservoir Length</u>

1. Normal pool: 2300± ft.

2. Flood control pool: N/A

3. Spillway crest pool: (top of stop planks) 2300± ft.

4. Top of dam pool: 2400± ft.

5. Test flood pool: 3500± ft.

e. <u>Reservoir Storage</u>

1. Normal pool: 175± acre-ft.

2. Flood control pool: N/A

3. Spillway crest pool: (top of stop planks) 175± acre-ft.

4. Top of dam pool: 230± acre-ft.

5. Test flood pool: 425± acre-ft.

f. <u>Reservoir Surface</u>

1. Normal pool: 12± acres

2. Flood control pool: N/A

3. Spillway crest pool: (Top of stop planks) 12± acres

4. Top of dam pool: 17± acres

indicates that the gate is not closed tightly or that it leaks, or possibly that there is seepage from the body of the dam into the pipe. No formal operational procedures exist.

## 1.3 PERTINENT DATA

a. Drainage Area - The drainage area is 73.4 square miles of largely undeveloped to heavily developed, flat and coastal terrain including large swamps. Significant upstream impoundments are Tiogue Lake, Stump Pond, Flat River Reservoir and Quidnik Reservoir.

b. Discharge at Damsite - Discharge is over the spillway and through the low-level outlet.

| | |
|---|---|
| 1. Outlet Works (conduits) 48 inch diameter steel low-level outlet pipe @ invert el. 93.8±: | 280 cfs (upstream water level at top of dam) |
| 2. Maximum known flood at damsite: | Since 1960 to about 1 foot below top of right non-overflow section (See Section 5.3) |
| 3. Ungated spillway capacity @ top of dam el. 111.3: | 2200 cfs |
| 4. Ungated spillway capacity @ test flood el. 118.9: | 13,100 cfs |
| 5. Gated spillway capacity @ normal pool: | N/A |
| 6. Gated spillway capacity @ test flood: | N/A |
| 7. Total spillway capacity @ test flood el. 118.9: | 13,100 cfs |
| 8. Total project discharge @ top of dam el. 111.3: | 2,480 cfs |
| 9. Total project discharge @ test flood el. 118.9: | 16,500 cfs |

c. Elevations - Elevations are on National Geodetic Vertical Datum (NGVD), based on an assumed elevation of 108.0 at the top of the stop planks, corresponding to the upstream water level shown on the USGS Crompton Quadrangle Map, 1970.

| | |
|---|---|
| 1. Streambed at toe of dam: | 81.7± |
| 2. Bottom of cutoff: | Not Known |

overflow section is the low point of the top of the dam. At elevation 111.3, it is 3.3 feet higher than the top of the stop planks and 0.4 foot lower than the top of the right non-overflow section.

A rack-with-pinion gate hoist is located on the top of the upstream masonry wall near the left end of the dam. The gate controls flow through a 48 inch diameter steel pipe which exits at invert elevation 93.8± from the downstream face of the left non-overflow section. The type and size of the gate are not known, but judging from the operating mechanism, it is probably a sluice gate.

c. Size Classification - (SMALL) - The dam is approximately 30 feet in height and with the upstream water level to the top of the dam, it impounds approximately 230 acre-feet of water. According to recommended guidelines, a dam between 25 and 40 feet in height and with a storage capacity between 50 and 1000 acre-feet is classified as small in size.

d. Hazard Classification - (HIGH) -If the dam were breached, there is potential for extensive property damage and economic loss as well as potential for loss of more than a few lives at industrial buildings located approximately 2500 and 3900 feet downstream of the dam. A breach of the dam could cause these buildings to be rapidly innundated with as much as 5 feet of water.

e. Ownership - Arctic Development Corporation
33 Factory Street
West Warwick, Rhode Island
Mr. Robert Galkin, President
Mr. Warren Galkin, Vice President
(401) 828-0300

The present owner purchased the dam from American Tourister Company in 1960. Westover Fabric Company was an earlier owner.

f. Operator - The owners are responsible for the operations of the project.

g. Purpose of Dam - Although the dam is not presently in use, a feasibility study to restore its hydroelectric generation capabilities is in progress.

h. Design and Construction History - Very little is known of the design and construction of the project. It is estimated that the dam was built around 1885. Originally there was a bridge across the spillway approach channel. The bridge was later removed but the date of removal is not known. The power generation facilities were shut down sometime before 1960 and the headrace channel filled around 1972.

i. Normal Operational Procedures - It appears that the low-level outlet for the dam is kept in a closed position and normal flow is over the stop planks. However, observed flow from the pipe

## 1.2 DESCRIPTION OF PROJECT

a. Location - The project is located on the South Branch of the Pawtuxet River in an industrial area of the City of West Warwick, County of Kent, State of Rhode Island. The dam is shown on the U.S.G.S. Crompton Quadrangle Map having coordinates latitude N 41° 42.4' and longitude W 71° 31.3'.

b. Description of Dam and Appurtenances - As shown on Sheet B-1, the 30 foot high dam is a stone-masonry gravity structure probably founded on bedrock for its entire length. The project is approximately 174 feet in length, consisting of a 110 foot long masonry spillway section centered between left and right masonry and earthfill non-overflow sections 42 and 22 feet in length, respectively. The low-level outlet is a 48 inch steel pipe through the left non-overflow section of the dam. Abandoned appurtenances are an old masonry bridge pier near the center of the spillway approach channel, and a filled-in headrace channel at the right end of the dam. Factory buildings are adjacent to both ends of the dam, masonry walls line the downstream channel, and a concrete arch roadway bridge crosses the river approximately 100 feet downstream of the dam.

The factory buildings at each end of the dam have first floor elevations approximately level with the top of the dam. It appears that these buildings are built on embankments which extend slightly in from the original river banks and are contiguous with the dam. The degree to which these structures contribute to the immpoundment of water on the upstream side of the dam is not determined, but for this inspection the exterior walls of the buildings are considered to be the endpoints of the dam; i.e., the length of the dam is equal to the distance between the two buildings.

The spillway is a broad crested masonry weir of trapezoidal cross-section, with permanently attached wooden stop planks. The top of the stop planks, at elevation 108, are approximately 2 feet higher than the masonry spillway crest. The spillway approach channel is shallow and gently sloping with an approximately 20 foot long by 5 foot wide masonry bridge pier near the center of the approach channel. The downstream face of the spillway is tiered and spillway discharge is onto the boulder-strewn natural river bottom. The river banks on each side of the downstream channel, between the dam and the roadway bridge consist of approximately 30 foot high vertical masonry retaining walls, with 5 to 8 foot wide benches at mid-height.

The right and left non-overflow sections of the dam each consist of upstream, downstream, and spillway-facing vertical masonry walls and a center earthfill. The masonry faces adjacent to each end of the spillway serve as training walls, the downstream faces connect to the retaining walls on each side of the downstream channel, and the upstream face of the right non-overflow section connects to the old headrace channel. The top of the left non-

PHASE I INSPECTION REPORT

ARTIC DAM

SECTION I - PROJECT INFORMATION

## 1.1 GENERAL

a. Authority - Public Law 92-367, August 8, 1972, authorized the Secretary of the Army, through the Corps of Engineers, to initiate a National Program of Dam Inspection throughout the United States. The New England Division of the Corps of Engineers has been assigned the responsibility of supervising the inspection of dams within the New England Region. Cahn Engineers, Inc. has been retained by the New England Division to inspect and report on selected dams in the State of Connecticut. Authorization and notice to proceed were issued to Cahn Engineers, Inc. under a letter of April 14, 1980 from William E. Hodgson, Jr., Colonel, Corps of Engineers. Contract No. DACW 33-80-C-0052 has been assigned by the Corps of Engineers for this work.

b. Purpose of Inspection Program - The purposes of the program are to:

1. Perform technical inspection and evaluation of non-federal dams to identify conditions requiring correction in a timely manner by non-federal interests.

2. Encourage and prepare the States to quickly initiate effective dam inspection programs for non-federal dams.

3. To update, verify and complete the National Inventory of Dams.

c. Scope of Inspection Program - The scope of this Phase I inspection report includes:

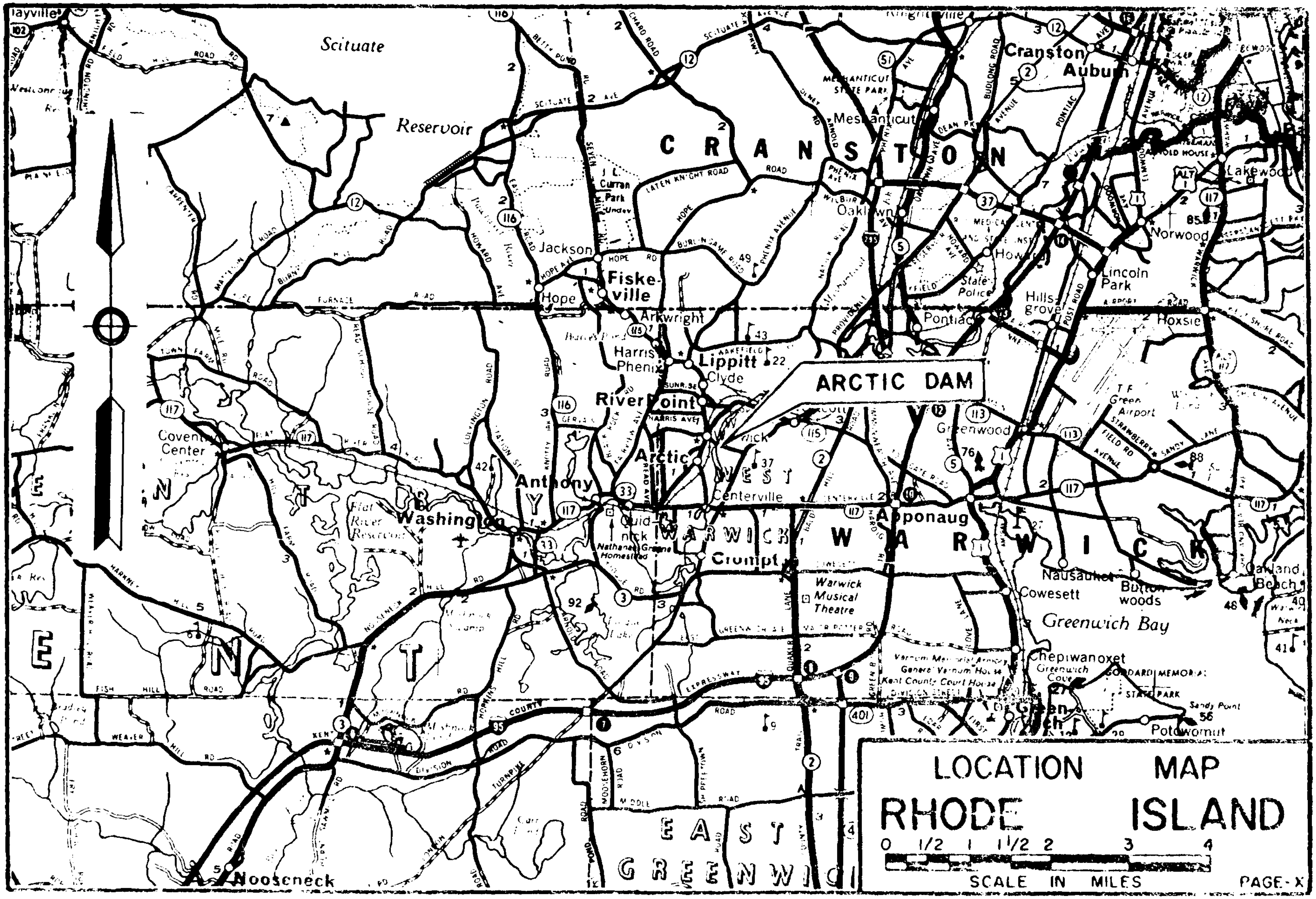
1. Gathering, reviewing and presenting all available data as can be obtained from the owners, previous owners, the state and other associated parties.

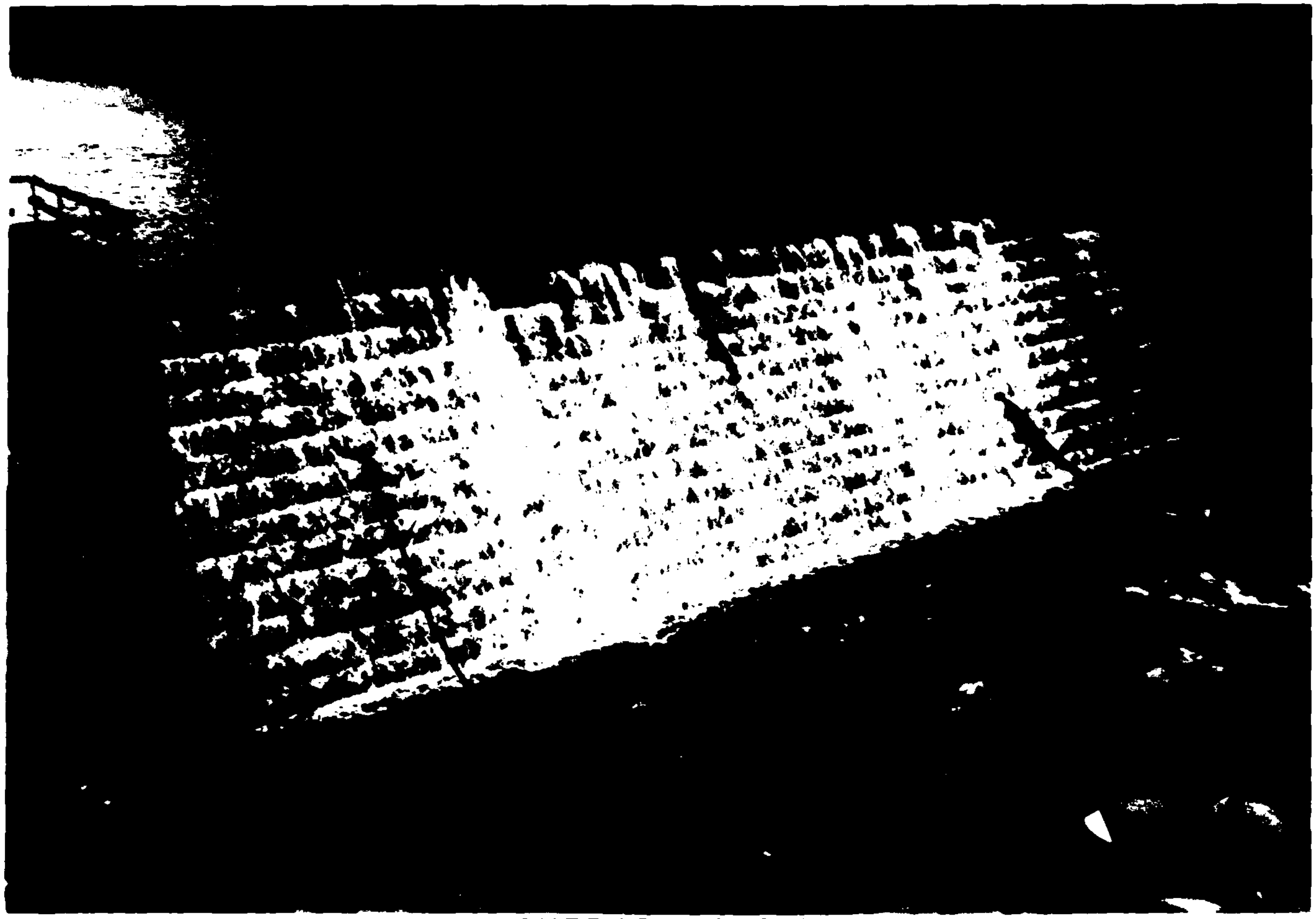
2. A field inspection of the facility detailing the visual condition of the dam, embankments and appurtenant structures.

3. Computations concerning the hydraulics and hydrology of the facility and its relationship to the calculated flood through the existing spillway.

4. An assessment of the condition of the facility and corrective measures required.

It should be noted that this report passes judgment only on those factors of safety and stability which can be determined by a visual surface examination. The inspection is to identify those visually apparent features of the dam which evidence the need for corrective action and/or further study and investigation.


ARCTIC DAM
LOCATION MAP
RHODE ISLAND
0 1/2 1 1 1/2 2 3 4
SCALE IN MILES
CRANSTON
WEST WARWICK
WARWICK
EAST GREENWICH
Scituate Reservoir
Cranston
Auburn
Knightsville
Meshanticut
Oaklawn
Norwood
Lakewood
Lincoln Park
Howard
State Police
Hillsgrove
Pontiac
Hoxsie
Jackson
Fiskeville
Hope
Arkwright
Harris
Phenix
Lippitt
Clyde
River Point
Arctic
Centerville
Anthony
Washington
Coventry Center
Flat River Reservoir
Quidnick
Crompton
Apponaug
Greenwood
T F Green Airport
Nausauket
Buttonwoods
Cowesett
Greenwich Bay
Chepiwanoxet
Oakland Beach
Potowomut
Nooseneck
Warwick Musical Theatre
Nathanael Greene Homestead
Goddard Memorial State Park



OVERVIEW PHOTO

| | | | | |
|---|---|---|---|---|
| US ARMY ENGINEER DIV. NEW ENGLAND<br>CORPS OF ENGINEERS<br>WALTHAM, MASS | NATIONAL PROGRAM OF<br>INSPECTION OF<br>NON-FED DAMS | Arctic Dam | W. Warwick | DATE Jan.'81 |
| CAHN ENGINEERS INC.<br>WALLINGFORD, CONN<br>ENGINEER | | S. Br. Pawtuxet River | Rhode Island | CE # 27 785 KG<br>PAGE ix |

## APPENDICES

trees. Also, they could be uprooted, causing damage to the dam.

2. The footpaths on the left non-overflow section are susceptible to erosion should this portion of the dam be overtopped.

3. The downstream masonry wall of the left non-overflow section could be weakened by leaching of the mortar joints.

4. Roots of the clump of small trees growing on top of the low-level outlet pipe could further penetrate the adjacent downstream wall of the dam, causing displacement of masonry.

5. Branches and debris at the toe of the left non-overflow section prevent close inspection of this area.

6. Further leaching of mortar joints of the masonry walls adjacent to each end of the spillway could weaken these walls.

7. Small trees growing on the masonry pier in the spillway approach channel could reduce the spillway capacity, especially if allowed to grow to be large trees.

8. If the low-level outlet gate is inoperable, it prevents lowering of the upstream water level should the need occur.

9. Continued rusting of the low-level outlet pipe along with possible leakage of the outlet gate could cause water to leak from the pipe into the body of the dam, possibly causing internal erosion of the dam.

10. The roots of brush and trees growing from the walls on each side of the downstream channel could cause displacement of masonry.

11. Undermining of the masonry wall along the right side of the downstream channel could threaten the stability of this wall.

## SECTION 4: OPERATIONAL AND MAINTENANCE PROCEDURES

### 4.1 OPERATIONAL PROCEDURES

a. General - Lake level readings are not taken and no regulating procedures are followed at the dam.

b. Description of Any Warning System in Effect - No formal downstream warning system is in effect.

### 4.2 MAINTENANCE PROCEDURES

a. General - Other than the regular cutting of grass on the right non-overflow section, and periodic removal of debris from the area of the spillway, there is no formal program of maintenance. The dam was inspected in September, 1978 by the State of Rhode Island Department of Environmental Management.

b. Operating Facilities - No formal program for maintenance of the operating facilities is in effect. It is not known when the low-level outlet gate was last operated.

### 4.3 EVALUATION

The operation and maintenance procedures are generally poor. A formal program of operations and maintenance procedures should be implemented, including documentation to provide complete records for future reference. Also, a formal warning system should be developed and implemented within the time frame indicated in Section 7.1c. Remedial operation and maintenance recommendations are presented in Section 7.3.

## SECTION 5: EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

### 5.1 GENERAL

The Arctic Dam watershed is 73.4 square miles of flat and coastal wooded terrain, typically containing large swamps and impoundments (Tiogue Lake, Stump Pond, Flat River and Quidnick Reservoirs) which contribute to the sluggish runoff characteristics of the watershed.

The dam is a masonry and earthfill dam with a masonry spillway. It is basically a low surcharge storage - high spillage type project. The reservoir area of approximately 12 acres is small in relation to the drainage area and consequently the surcharge storage of the project is too small to have an appreciable effect in reducing the ½ PMF outflow of 16,500 cubic feet per second (cfs).

### 5.2 DESIGN DATA

No computations could be found for the original design of the dam.

### 5.3 EXPERIENCE DATA

The owner reports that since 1960, the highest observed water level was approximately 1 foot below the top of the right non-overflow section. This water level is about ½ foot below the first point of overtopping of the left non-overflow section and may correspond to the flow of 2,000 cfs recorded on the river in 1968.

### 5.4 TEST FLOOD ANALYSIS

Based upon the watershed classification (Flat and Coastal), and the watershed area of 73.4 square miles; and utilizing the guide curve (Appendix D, p. v) in the U.S. Army Corps of Engineers "Preliminary Guidance for Estimating Maximum Probable Discharges", a PMF of 33,000 cfs or 450 cfs per square mile is estimated at the damsite. In accordance with the size (small) and hazard (high) classification, the range of test floods to be considered is from the ½ PMF to the PMF. Based on the degree of hazard associated with a breach of the dam, the test flood for Arctic Dam is equivalent to the ½ PMF. The pond level at the start of the test flood is considered to be at the top of the stop planks at elevation 108.0. The peak outflow for the test flood is estimated at 16,500 cfs and this flow will overtop the dam by 7.6 feet. Based on hydraulics computations, the spillway capacity above the stop planks to the top of the dam is 2,200 cfs which is equivalent to 13% of the routed test flood outflow (Appendix D-4).

## 5.5 DAM FAILURE ANALYSIS

Upon failure of Arctic Dam, the downstream impact area consists of two industrial buildings located 2500 and 3900 feet downstream of Arctic Dam. Both of these buildings are constructed adjacent to dams and portions of both buildings extend along the upstream impoundments as well as along the downstream discharge channels of their respective dams. At each location, the first floor elevation of the portion of the building upstream of the dam is approximately level with the top of the dam and 5 feet above the spillway crest. On the downstream side of each dam, the elevation above the spillway discharge channel of the first floors of these buildings is 7 feet at the upper dam and 11 feet at the lower dam.

The dam failure analysis is based on the April, 1978 Army Corps of Engineers "Rule of Thumb Guidance for Estimating Downstream Dam Failure Hydrographs". With the pond level at the top of the dam, peak outflow before failure of the dam would be about 2,200 cfs and the peak failure outflow from the dam breaching would total about 18,300 cfs.

Prior to failure of Arctic Dam the depth of flow over the spillway at the upper of the two downstream impoundments would be approximately 3.2 feet, or 1.8 feet below the first floor elevation of the adjacent building. Failure of Arctic dam would result in a 6.7 foot increase in water level to a depth of 9.9 feet above the spillway crest. This rapid increase in water level will innundate the building by approximately 4.9 feet.

At the spillway of the lower downstream impoundment, the prefailure flow depth would be approximately 3.6 feet, or 1.4 feet below the first floor elevation of the adjacent building. Failure of Arctic Dam would result in a 5.1 foot increase in water level to a depth of 8.7 feet above the spillway crest, innundating the building by approximately 3.7 feet.

Innundation of portions of these buildings has the potential to cause economic losses and the loss of more than a few lives. Therefore, Arctic Dam is classified as a high hazard dam (Appendix D-9).

## SECTION 6: EVALUATION OF STRUCTURAL STABILITY

### 6.1 VISUAL OBSERVATIONS

The dam is a masonry gravity structure and appears to be founded on bedrock. The configuration of the upstream face of the spillway is not known and the downstream face is tiered, giving the masonry spillway section a base width of at least 15 feet, if the upstream face is vertical. The non-overflow sections of the dam have vertical masonry walls around their perimeters and inner earthfill. The masonry walls have top widths of approximately 3 feet, but their base widths are not known. Although several design features are not known, there are no visual indications of a structurally unstable design.

The areas of deterioration described in Section 3 are not considered to be stability concerns at the present time. However, if left unchecked, leaching of mortar joints and leakage from the low-level outlet pipe could cause instability of the left non-overflow section, and continued undermining of the masonry wall along the right side of the downsteam channel could cause it to become unstable.

### 6.2 DESIGN AND CONSTRUCTION DATA

No information is available.

### 6.3 POST-CONSTRUCTION CHANGES

Post-construction changes to the project include filling of the headrace channel at the right end of the dam and removal of a bridge across the spillway approach channel. Neither of these changes appears to affect the stability of the structure. No other post-construction changes are known.

### 6.4 SEISMIC STABILITY

The project is located near the boundary between Seismic Zones 1 and 2 and, according to U.S. Army Corps of Engineers Recommended Guidelines, need not be evaluated for seismic stability.

## SECTION 7: ASSESSMENT, RECOMMENDATIONS AND REMEDIAL MEASURES

### 7.1 DAM ASSESSMENT

a. Condition - Based upon the visual inspection of the site and past performance, the dam is in fair condition. No evidence of immediate structural instability was observed in the dam or appurtenances; however, there are areas which require repair and/or maintenance.

Based upon the Army Corps of Engineers' "Preliminary Guidance for Estimating Maximum Probable Discharges" dated March, 1978, the watershed classification and hydraulic/hydrologic computations, peak inflow to the pond at test flood is 16,500 cubic feet per second (cfs); peak outflow is 16,500 cfs with the dam overtopped 7.6 feet. Based upon our hydraulic computations, the spillway capacity to the top of dam is 2200 cfs, which is equivalent to approximately 13% of the routed test flood outflow. This indicates an inadequate spillway capacity.

b. Adequacy of Information - The information available is such that an assessment of the condition and stability of the project must be based solely on visual inspection, past performance and sound engineering judgement.

c. Urgency - It is recommended that the measures presented in Section 7.2 and 7.3 be implemented within one year of the owner's receipt of this report.

### 7.2 RECOMMENDATIONS

It is recommended that further studies pertaining to the following items be made by a registered professional engineer qualified in dam design and inspection. Recommendations made by the engineer should be implemented by the owner.

1. A detailed hydraulic/hydrologic analysis to determine the adequacy of the project discharge capacity and overtopping potential.

2. Inspection of the downstream face and toe of the spillway section with the upstream water level just below the spillway crest.

3. Inspection of the inside of the 48 inch steel low-level outlet pipe, determination of the source of leakage through the pipe, and repair or replacement of the pipe.

4. Determination of the cause of leaching of the mortar from joints in the masonry, particularly near the low-level outlet pipe's exit from the downstream face of the dam and repair of the mortar joints.

5. Repair or replacement of the low-level outlet gate and gate hoisting mechanism.

6. Repair of undermined areas of the masonry wall along the right side of the downstream channel.

7. Removal of all trees from the dam and from within 10 feet of the toe of the dam, including proper backfilling with selected material.

## 7.3 REMEDIAL MEASURES

Operation and Maintenance Procedures - The following measures should be undertaken by the owner within the length of time indicated in Section 7.1.c, and continued on a regular basis.

1. Round-the-clock surveillance should be provided during periods of heavy precipitation or high project discharge. A formal downstream warning system should be developed to be used in case of emergencies at the dam.

2. A formal program of operation and maintenance procedures should be instituted and fully documented to provide accurate records for future reference.

3. A comprehensive program of inspection by a registered professional engineer qualified in dam inspection should be instituted on an annual basis.

4. Brush and saplings should be removed from the dam and appurtenant structures and from within 10 feet of the toe of the dam.

5. Grass cover should be established on the left non-overflow section.

6. Branches and debris should be removed from an area extending to approximately 10 feet from the toe of the left non-overflow section so that the toe can be inspected.

7. Leached or cracked mortar joints on the dam and appurtenant structures should be repaired and maintained as part of normal maintenance procedures at the site.

8. The practice of clearing debris from the spillway crest, from the downstream face of the spillway, and from the toe of the spillway should be continued as part of normal maintenance procedures at the site.

9. The rotted wooden railing along the top of the right non-overflow section should be repaired.

## 7.4 ALTERNATIVES

This study has identified no practical alternatives to the above recommendations

# APPENDIX A

# INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST

PARTY ORGANIZATION

PROJECT Arctic Dam

DATE: Oct. 8, 1980

TIME: 9:30 am

WEATHER: Fair 50°

W.S. ELEV. 1082± U.S. 82.0± DN.S

| PARTY: | INITIALS: | DISCIPLINE: |
|---|---|---|
| 1. Peter Heynen | PH | Geotechnical |
| 2. Theodore Stevens | TS | Geotechnical |
| 3. Hector Moreno | HM | Hydraulics |
| 4. Frank Segeline | FS | Survey |
| 5. | | |
| 6. | | |

| PROJECT FEATURE | INSPECTED BY | REMARKS |
|---|---|---|
| 1. Right Non-overflow Section | TS, PH, HM | |
| 2. Left Non-overflow Section | TS, PH, HM | |
| 3. Intake Structure | TS, PH, HM | |
| 4. Low-level Outlet | TS, PH, HM | |
| Spillway | TS, PH, HM | |
| 6. | | |
| 7. | | |
| 8. | | |
| 9. | | |
| 10. | | |
| 11. | | |
| 12. | | |

PERIODIC INSPECTION CHECK LIST

Page A-2

PROJECT Arctic Dam DATE 10-8-80

PROJECT FEATURE Right Non-overflow Section BY TS, PH, HM

| AREA EVALUATED | CONDITION |
|---|---|
| DAM EMBANKMENT | |
| Crest Elevation | 111.7± |
| Current Pool Elevation | 108.2± |
| Maximum Impoundment to Date | 110.4± (since 1960) |
| Surface Cracks | None observed |
| Pavement Condition | N/A |
| Movement or Settlement of Crest | None observed |
| Lateral Movement | None observed |
| Vertical Alignment | Appears good |
| Horizontal Alignment | Appears good |
| Condition at Abutment and at Concrete Structures | Appears good-at building |
| Indications of Movement of Structural Items on Slopes | N/A |
| Trespassing on Slopes | N/A |
| Sloughing or Erosion of Slopes or Abutments | None observed |
| Rock Slope Protection-Riprap Failures | N/A |
| Unusual Movement or Cracking at or Near Toes | None observed |
| Unusual Embankment or Downstream Seepage | None observed |
| Piping or Boils | None observed |
| Foundation Drainage Features | N/A |
| Toe Drains | N/A |
| Instrumentation System | N/A |

PERIODIC INSPECTION CHECK LIST

Page A-3

PROJECT Arctic Dam    DATE 10-8-80

PROJECT FEATURE Left Non-overflow Section BY TS, PH, HM

| AREA EVALUATED | CONDITION |
|---|---|
| M EMBANKMENT | |
| est Elevation | 111.3 ± |
| rrent Pool Elevation | 108.2 ± |
| ximum Impoundment to Date | 110.4 ± (since 1960) |
| rface Cracks | None observed |
| vement Condition | N/A |
| vement or Settlement of Crest | None observed |
| teral Movement | None observed |
| rtical Alignment | Appears good |
| rizontal Alignment | Appears good |
| ...tion at Abutment and at Concrete ...ctures | Appears good - at building |
| ...ations of Movement of Structural ... on Slopes | N/A |
| ... on Slopes | Footpaths on top |
| ... of Erosion of Slopes or ... | ... erved |
| ... Failure | N/A |
| ... King at or ... | Toe obscured by debris |
| ... Embankment ... Downstream ... | Seepage through low-level outlet onto D/S face of dam causing leaching of joints |
| ... Boils | None observed |
| [illegible] | N/A |
| [illegible] | N/A |
| ...mentation System | N/A |

A-3

PERIODIC INSPECTION CHECK LIST

Page A-4

PROJECT Arctic Dam DATE 10-8-80

PROJECT FEATURE Intake Structure BY TS, PH, HM

| AREA EVALUATED | CONDITION |
|---|---|
| OUTLET WORKS-INTAKE CHANNEL AND INTAKE STRUCTURE | |
| a) Approach Channel | Approach channel under water - could not observe |
| Slope Conditions | |
| Bottom Conditions | |
| Rock Slides or Falls | |
| Log Boom | |
| Debris | |
| Condition of Concrete Lining | |
| Drains or Weep Holes | |
| b) Intake Structure | |
| Condition of Concrete | Masonry intact-no deterioration |
| Stop Logs and Slots | Gate-hoisting mechanism (rack-with-pinion) in poor condition - rusted steel, rotting wood. Location of handle not known |

PERIODIC INSPECTION CHECK LIST

Page A-5

PROJECT Arctic Dam

DATE 10-8-80

PROJECT FEATURE Low-level Outlet

BY TS, PH, HM

| AREA EVALUATED | CONDITION |
| --- | --- |
| T WORKS-OUTLET STRUCTURE AND OUTLET CHANNEL | |
| all Condition of Concrete | Masonry - fair condition - leaching of mortar joints |
| or Staining | Severe rusting of 48" pipe |
| ing | N/A |
| on or Cavitation | None observed |
| ble Reinforcing | N/A |
| Seepage or Efflorescence | None observed |
| ition at Joints | Poor - leached out |
| Holes | N/A |
| nel | |
| se Rock or Trees Overhanging Channel | Many small trees near outlet |
| dition of Discharge Channel | N/A - Discharge almost directly to D/S channel |

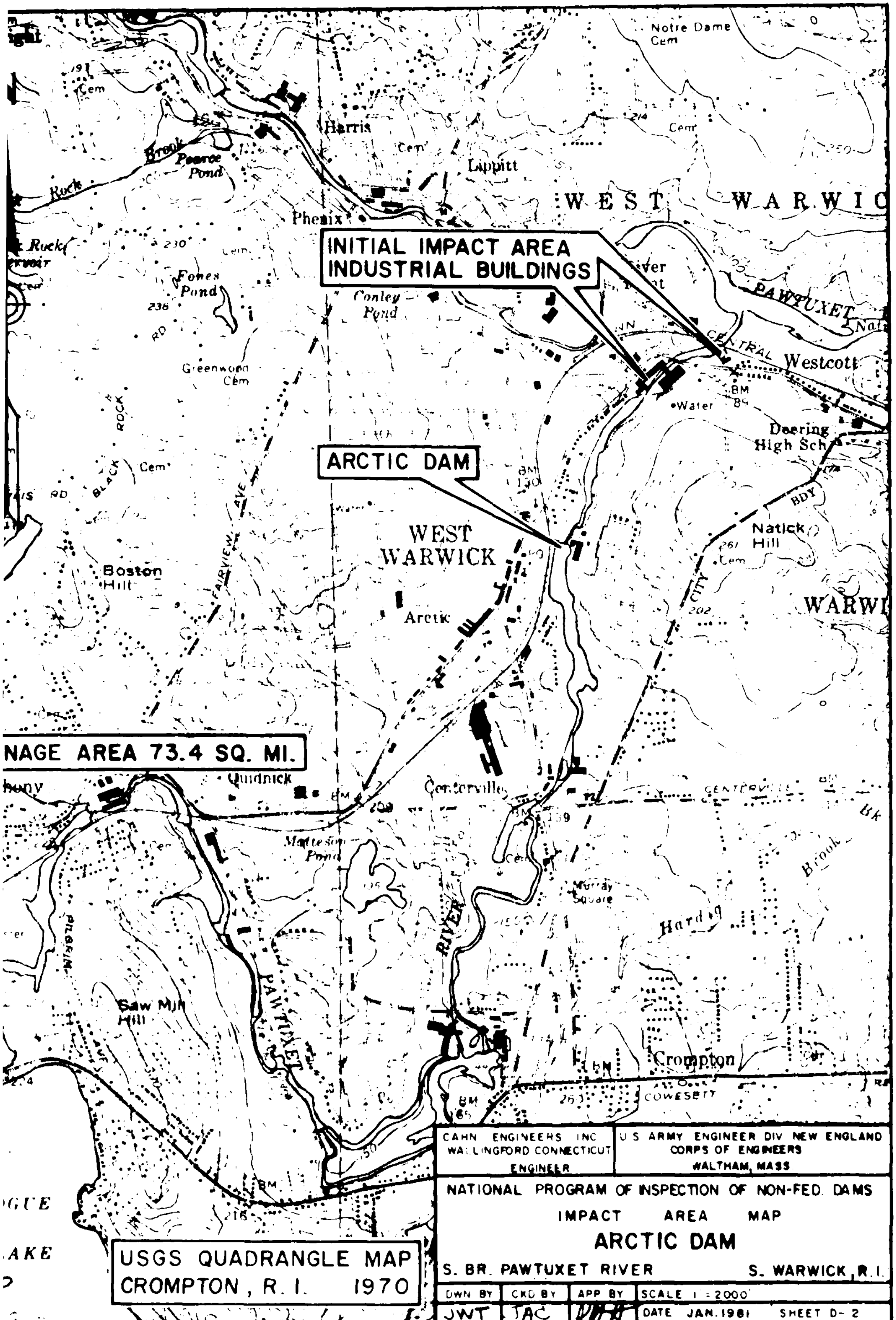
PERIODIC INSPECTION CHECK LIST

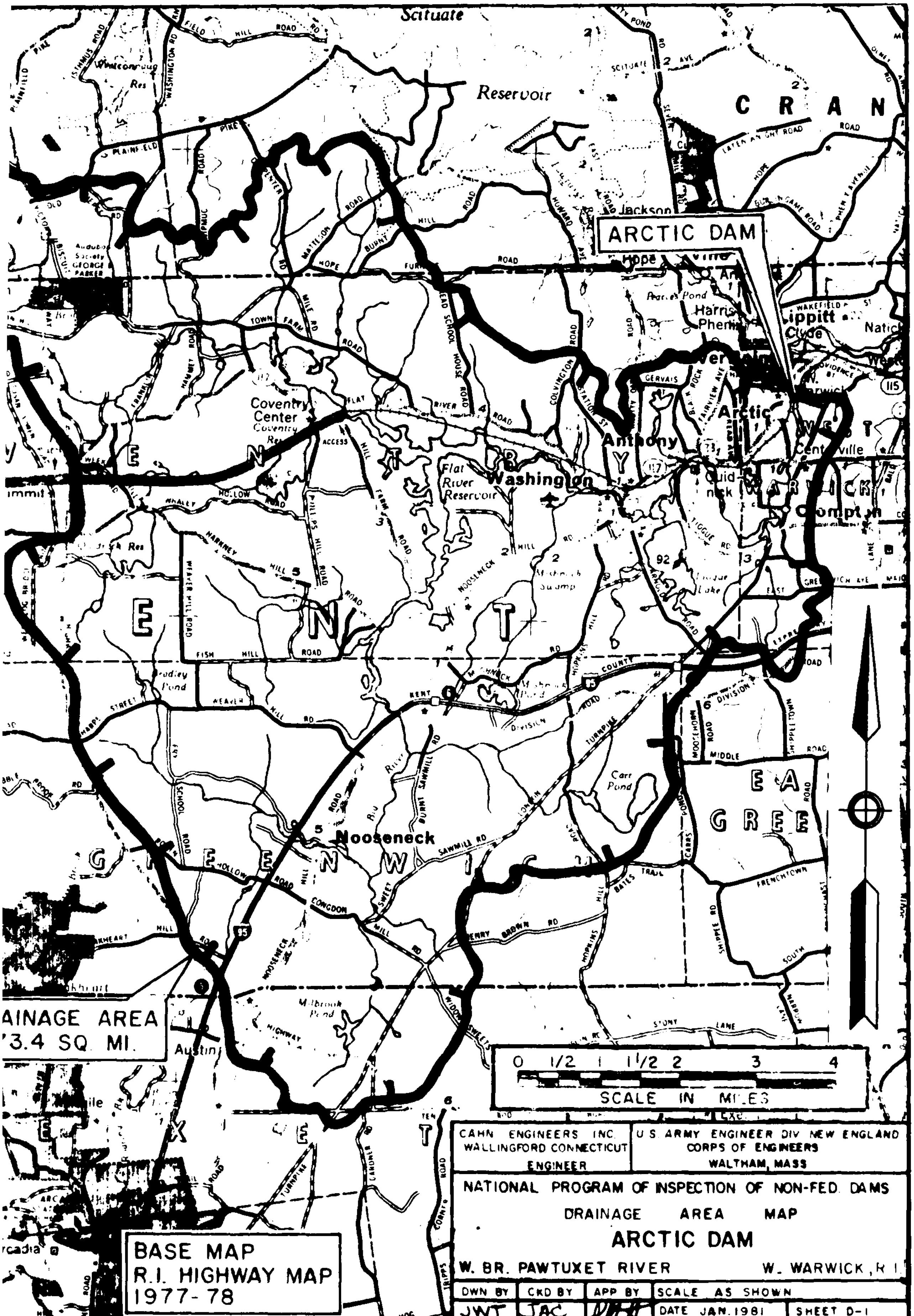
Page A-6

PROJECT Arctic Dam 10-8-80

PROJECT FEATURE Spillway BY TES, PB, HM

| AREA EVALUATED | CONDITION |
| --- | --- |
| OUTLET WORKS-SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS | |
| Approach Channel | |
| General Condition | Good |
| Loose Rock Overhanging Channel | No |
| Trees Overhanging Channel | Small trees on pier |
| Floor of Approach Channel | Shallow, sandy |
| Weir and Training Walls | |
| General Condition of ~~Concrete~~ Masonry | Good |
| Rust or Staining | Minor staining of walls-from spray |
| Spalling | None observed |
| Any Visible Reinforcing | N/A |
| Any Seepage or Efflorescence | None observed |
| Drain Holes | N/A |
| Discharge Channel | |
| General Condition | Shallow, broad, boulders |
| Loose Rock Overhanging Channel | No |
| Trees Overhanging Channel | Minor |
| Floor of Channel | Boulders |
| Other Obstructions | None observed |


INITIAL IMPACT AREA
INDUSTRIAL BUILDINGS
ARCTIC DAM
NAGE AREA 73.4 SQ. MI.
WEST WARWICK
Harris
Lippitt
Phenix
Pearce Pond
Fones Pond
Conley Pond
Greenwood Cem
Notre Dame Cem
Westcott
PAWTUXET
CENTRAL
Deering High Sch
Natick Hill
Boston Hill
FAIRVIEW AVE
BLACK ROCK RD
Arctic
WARWI
Quidnick
Centerville
Matteson Pond
Murray Square
Harding
PAWTUXET RIVER
Saw Mill Hill
PILGRIM AVE
Crompton
COWESETT
CENTERVILLE
CITY
BDY
USGS QUADRANGLE MAP
CROMPTON, R.I. 1970
CAHN ENGINEERS INC
WALLINGFORD CONNECTICUT
ENGINEER
U.S. ARMY ENGINEER DIV NEW ENGLAND
CORPS OF ENGINEERS
WALTHAM, MASS.
NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS
IMPACT AREA MAP
ARCTIC DAM
S. BR. PAWTUXET RIVER
S. WARWICK, R.I.
DWN BY
JWT
CKD BY
TAC
APP BY
SCALE 1 : 2000
DATE JAN. 1981
SHEET D-2




| CAHN ENGINEERS INC. WALLINGFORD CONNECTICUT ENGINEER | U.S. ARMY ENGINEER DIV. NEW ENGLAND CORPS OF ENGINEERS WALTHAM, MASS. |
|---|---|

NATIONAL PROGRAM OF INSPECTION OF NON-FED. DAMS

DRAINAGE AREA MAP

ARCTIC DAM

W. BR. PAWTUXET RIVER — W. WARWICK, R.I.

| DWN BY | CKD BY | APP BY | SCALE AS SHOWN | |
|---|---|---|---|---|
| JWT | JAC | | DATE JAN. 1981 | SHEET D-1 |

Photo 5 - Benched channel bank retaining wall between arch bridge at left and dam at right (10/8/80).

Photo 6 - Undermining at base of retaining wall. Note depth of flow and pattern of current under wall (10/8/80).

| | | |
|---|---|---|
| US ARMY ENGINEER DIV NEW ENGLAND<br>CORPS OF ENGINEERS<br>WALTHAM, MASS | NATIONAL PROGRAM OF | Arctic Dam<br>S. B. Pawtuxet River |
| CAHN ENGINEERS INC<br>WALLINGFORD, CONN<br>ENGINEER | INSPECTION OF<br>NON-FED. DAMS | W. Warwick, R.I.<br>CE # 27 785 KG<br>DATE Jan. '81 PAGE C-3 |

Photo 3 - Downstream face of spillway, spillway crest with permanent stop planks, and bridge pier in approach channel (10/8/80).

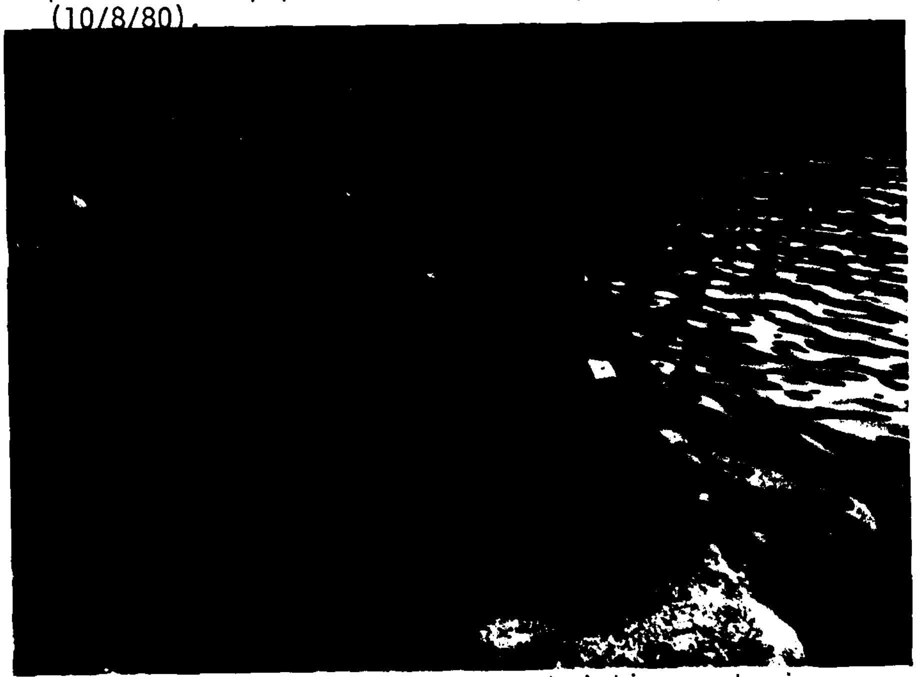


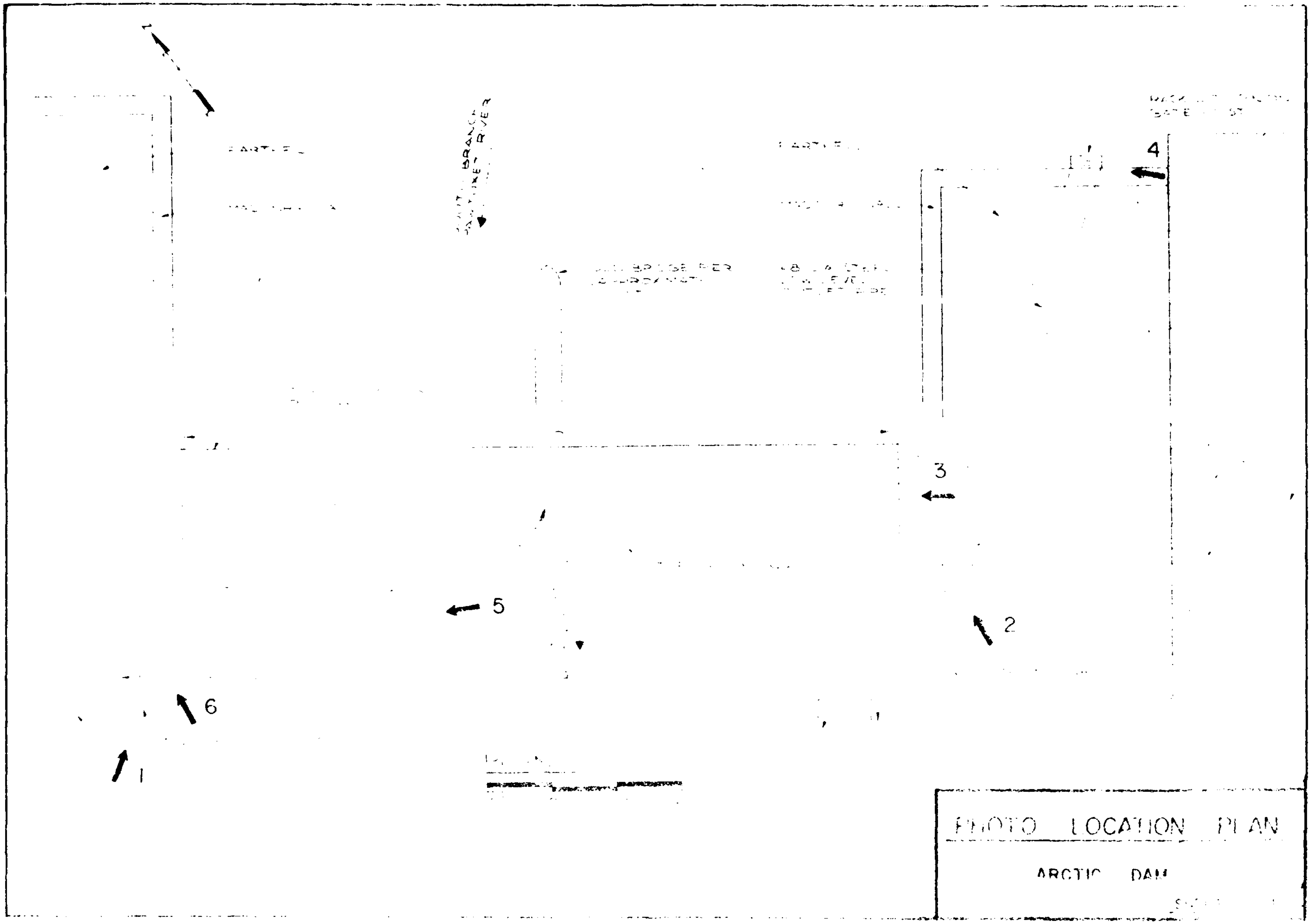
Photo 4 - Rack-with-pinion gate hoisting mechanism (10/8/80).

| | | |
|---|---|---|
| US ARMY ENGINEER DIV. NEW ENGLAND<br>CORPS OF ENGINEERS<br>WALTHAM, MASS | NATIONAL PROGRAM OF<br>INSPECTION OF<br>NON-FED. DAMS | Arctic Dam<br>S. Br. Pawtuxet River<br>W. Warwick, R.I.<br>CE# 27 785 KG |
| CAHN ENGINEERS INC.<br>WALLINGFORD, CONN<br>ENGINEER | | DATE Jan. '81 PAGE C-2 |

Photo 1 - Right non-overflow section of dam and adjacent factory building (10/8/80).

Photo 2 - Downstream end of low-level outlet pipe. Note deterioration of pipe and leached-out mortar joints on [illegible] (10/8/80).

| | | |
|---|---|---|
| U.S. ARMY ENGINEER DIV. NEW ENGLAND<br>CORPS OF ENGINEERS<br>WALTHAM, MASS. | NATIONAL PROGRAM OF<br>INSPECTION OF<br>NON-FED. DAMS | Arctic Dam<br>[illegible] Pawtuxet [illegible]<br>W. Warwick, R.I. |
| CAHN ENGINEERS INC.<br>WALLINGFORD, CONN.<br>ENGINEER | | CE # 27 7[illegible]5 [illegible]<br>DATE Jan. '81 PAGE [illegible] |


1
2
3
4
5
6
1
PHOTO LOCATION PLAN
ARCTIC DAM

# APPENDIX C

# DETAIL PHOTOGRAPHS

DEPARTMENT OF ENVIRONMENTAL MANAGEMENT

DAM INSPECTION REPORT

RIVER: Pawtuxet R/South

Arctic Pond Dam TOWN: West Warwick INSPECTED BY: Earle F. Prout, Jr.

Arctic Development Corp.
53 Factory Street
West Warwick, RI

OTHER INTERESTED PARTY: Natco Products Corp.
c/o Arctic Development Corp.

Dam Inspection:

* * * * * * * * * * * * * * * * * * * * * * * * * * * * *

General: Dam built in 1885 for industrial power use.

Current Pool Elevation: 2" above crest of spillway.

Dam Embankment: The spillway spans the entire width of river with mill buildings on both sides.

Outlet: Draw-off; located on left (west) side of spillway, "rack and pinion" type gear mechanism is currently intact and although its operability was not tested, it appears to be mechanically sound. The rack timber is beginning to show signs of age, and its replacement is suggested (photo 2).

Sluiceway Gates: Located on right (east) side of spillway has been completely filled in - date unknown. The approach to the draw-off gates is clear and unobstructed. The outlet is through a large (3'$\pm$) metal pipe discharging back into river directly below spillway. There is presently a small amount of water flowing from the outlet structure indicating that the gate is slightly open (or leaking).

Spillway: The approach to the spillway is clear and unobstructed. There are no visible deficiencies across the crest of the spillway. The spillway is constructed of heavy granite block with stepped masonry face (photo #1). The stability of the crest and face was undetermined because of the full flow conditions; however, there were no visible deficiencies [illegible] any doubt as to its structural integrity.

The heavy masonry abutment walls on both sides of the spillway appear to be structurally sound. However, there is a heavy growth of brush and [illegible] on the left side which should be removed. The spillway discharge is clear and unobstructed.

Findings/Recommendations: The spillway structure appears to be in generally good condition. It is recommended, however, that the owner investigate the possible leaking condition of the draw-off gate and repair if necessary - along with the replacement of the rack timber. Also, removal of brush and shrubs from the top of the left abutment is suggested.

| Dam Name | Arctic (Factory St) | Riverpoint Upper | Riverpoint Lower |
| --- | --- | --- | --- |
| Dam No. | 148 | 147 | 146 |
| Area of Watershed (nearest 1/10 sq. mi.) | 73.4 | 73.7 | 73.8 |
| Peak Discharge Rate of Watershed (CFS) | 4844 | 4864 | 4761 |
| [illegible] normal water level [illegible] (Ft.) | 108.0 | | |
| [illegible] Surface (nearest acre) | 14 | 6 | 4 |
| [illegible] of Spillway (Ft.) | 110.5 | 79.1 | 51.3 |
| [illegible] Emergency Spillway (Ft.) | | | 5.0 |
| [illegible] of Spillway (Ft) | 100 | 120 | 100 |
| Maximum Capacity of Spillway (CFS) | | | 3900 |
| Max Storm Discharge Capacity (CFS) | | | 5844 |
| Structural Height (Ft.) | 27 | | |
| Hydraulic Height (Ft.) | 24 | | |
| Impounding Capacity (Max.) | 194 acre-ft. | | |
| Impounding Capacity (Normal) | 173 acre-ft | | |
| [illegible] Drawoff (Ft.) | 20 | 40 | 40 |
| Number of Wheels | 2 | 1 | |
| [illegible] Wheel (Ft.) | 28 | 22 | |
| [illegible] | 500 HP | 3[illegible],400KW | |
| [illegible] River Bed (Ft.) | 29 | | 5 |
| [illegible] normal water [illegible] Below Dam | | | 50 ft |

DIVISION [illegible]

SURVEY OF DAMS IN RHODE ISLAND

Pawtuxet River Basin (South Branch) — #143 Arctic

Drainage Area 73.4 Sq. Mi.

February 1948

Spillway

Estimated extreme freshet 4844 c.f.s.

R. I. DEPARTMENT OF PUBLIC WORKS
DIVISION OF HARBORS AND RIVERS

SPECIAL INSPECTION REPORT

DAM NO. 146

TOWN - WEST WARWICK

NAME ARCTIC ON RIVER PAWTUXET WATERSHED PAWTUXET

WEST WARWICK, R. I., TEL.

NEW CONSTRUCTION REPAIRS INSPECTION ONLY x

APPROVED CONTRACTOR

INSPECTION REPORT BY ... PERCY ... ROUTE ... DATE

EMERGENCY:

1. ~~CHARLES ... CAPTAIN MECHANIC, ... WEST WARWICK~~

2. WILLIAM JENNINGS, SUPT., ~~POTTER AVE.~~, WEST WARWICK, R. I.

3. ~~HARRY ...~~

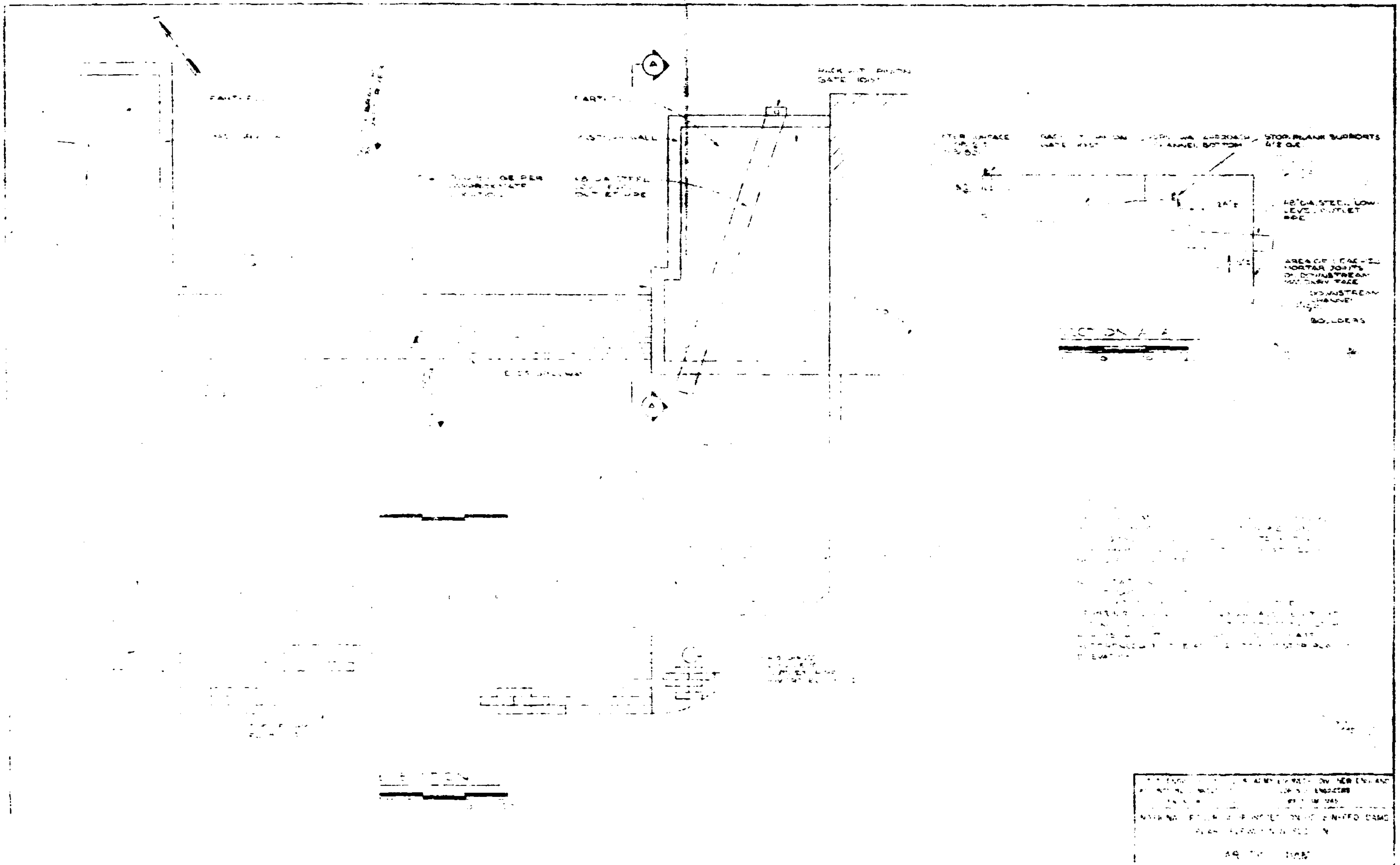
CONDITION GOOD. HEAVY GRANITE SPILLWAY BETWEEN MASSIVE GRANITE ABUTMENTS SPANS ENTIRE RIVER. TRENCH ON EAST SIDE OF RIVER LEADS TO WATER WHEELS IN MILL AND IS CONTROLLED BY TWO SETS OF GATES (ALL IN GOOD OPERATING CONDITION - REPAIRED 1945). 29" PERMANENT FLASH BOARD NOW IN PLACE (WOODEN WITH IRON SUPPORTS). TWO WHEELS AVAILABLE FOR POWER CAN DEVELOP 500 H.P. ONE NEW IN 1940. DAM UNDER CONSTANT SUPERVISION OF MASTER MECHANIC AND GAGE READ EVERY HOUR DAILY FROM 7 A. M. TO 11 P. M.

6/9/48

REQUEST FROM ATTY. BOLMAN FOR ARTISTIC FOUNDATION CO. (AT RIVERPOINT FINISHING CO. PLANT, NEXT BELOW - #147) AS TO OUR KNOWLEDGE OF A BREAK IN FLASH BOARD AT WESTOVER #145 ON MARCH 2, 1947, CAUSING LOSS OF CONSIDERABLE CLOTH AND FLOODING OF THEIR MILL. THIS OFFICE HAD RECEIVED NO NOTICE OF THIS FAILURE.

## SUMMARY OF DATA AND CORRESPONDENCE

| DATE | TO | FROM | SUBJECT | PAGE |
|---|---|---|---|---|
| Mar. 27, 1946 | File | J. V. Keily<br>R. I. Dept. of Public Works<br>Division of Harbors and Rivers | Inspection Report | B-2 |
| Feb. 1948 | File | Division of Harbors and Rivers | Hydraulic/Hydrologic Date | B-3 |
| Sept. 11, 1978 | File | Earle F. Prout, Jr.<br>R.I. Dept. of Environmental Manage-<br>ment | Inspection Report | B-5 |


STOP PLANK SUPPORTS
4'± O.C.
CHANNEL BOTTOM
GATE POST
LEVEL OUTLET
AREA OF LEAK
MORTAR JOINTS
DOWNSTREAM
DOWNSTREAM
CHANNEL
BOULDERS
GATE
EARTH
WALL
NEW ENGLAND
ENGINEERS
DAMS

# APPENDIX B

# ENGINEERING DATA AND CORRESPONDENCE

# Cahn Engineers Inc. Consulting Engineers

Project: Inspection of Non-Federal Dams in New England  Sheet: D-1 of ___
Computed By: ___  Checked By: ___  Date: ___
Field Book Ref. ___  Other Refs. ___  Revisions ___

HYDROLOGIC, HYDRAULIC INSPECTION

ARCTIC DAM, WEST WARWICK, R.I.

I) PERFORMANCE AT PEAK FLOOD CONDITIONS

1) PROBABLE MAXIMUM FLOOD (PMF)

a) WATERSHED CLASSIFIED AS "FLAT AND COASTAL", TYPICALLY CONTAINING LARGE SWAMPS AND IMPOUNDMENTS (FLAT RIVER AND ... RESERVOIRS)

b) WATERSHED AREA: $D.A. = 73.4$ sq.mi.

NOTE: D.A. FROM R.I. DEPARTMENT OF NATURAL RESOURCES ... "SURVEY OF DAMS IN RHODE ISLAND" DAM #185 ...

2) PEAK FLOODS (FROM NED-ACE GUIDELINES - GUIDE CURVES FOR PMF)

i) FROM GUIDE CURVES: $CSM = 450$ cfs/sq.mi.

ii) $PMF = 73.4 \times 450 = \underline{33000}$ cfs

iii) $\frac{1}{2}\ PMF = \underline{16500}$ cfs

... DISCHARGE AT PEAK INFLOWS (PMF AND ½ PMF)

a) OUTFLOW RATING CURVE

i) ... AND ... PROFILE ... DAM.

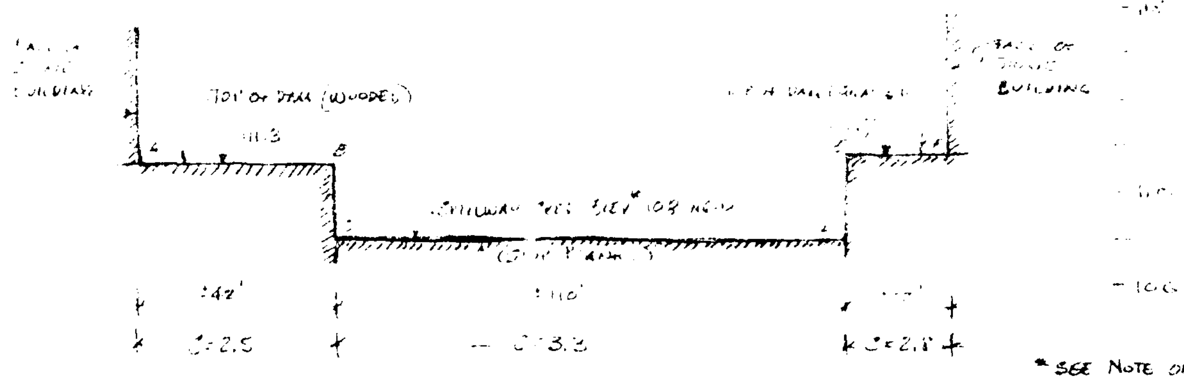
STONE MASONRY ... WITH ... STONE MASONRY AND EARTH FILL ... ON BOTH SIDES OF ... ADJACENT STONE BUILDING WHICH ... THE OVERFLOW SECTION ...

*NOTE: U.S. ELEVATION ... MSL ON THE USGS ... IS ASSUMED TO BE TOP OF ... ELEVATION ON NATIONAL GEODETIC ... DATUM (NGVD)

# Cahn Engineers Inc. Consulting Engineers

Subject [illegible] Sheet [illegible] of ____
Computed By [illegible] Checked By [illegible] Date [illegible]
Field Book Ref ____ Other Refs [illegible] Revisions ____

ASSUME C=3.3 FOR THE SPILLWAY [illegible] AND [illegible] FOR THE RIGHT & LEFT ABUTMENT OVERFLOW



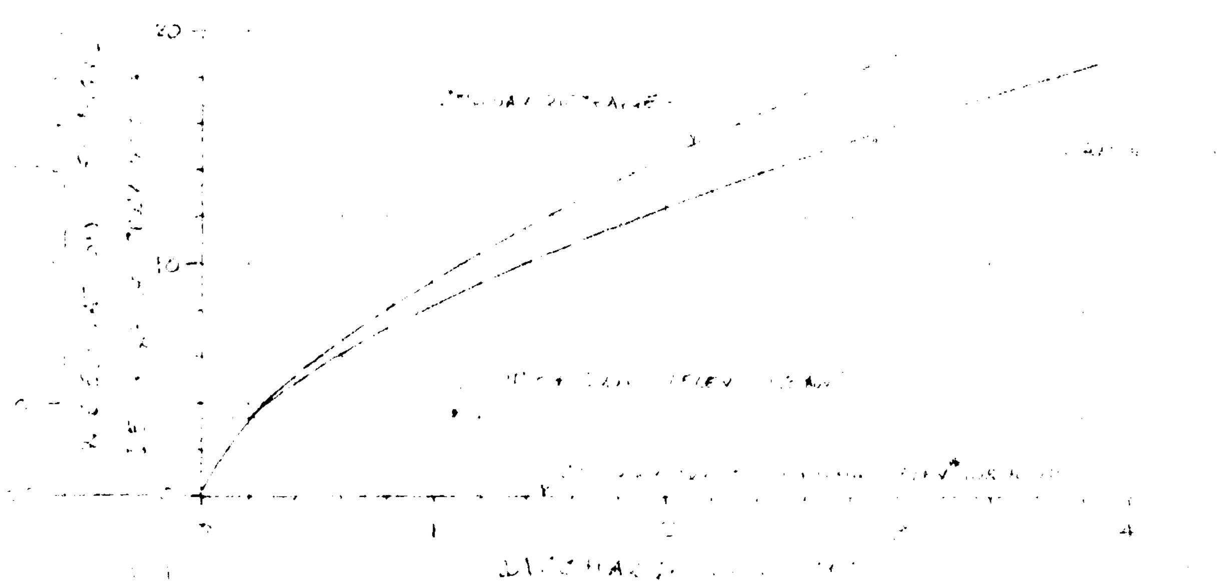

* SEE NOTE ON P. D-1

NOTE DATA FROM CE OBSERVATIONS ON 11/8/80 BY [illegible], F.S & T.S.

ARCTIC DAM
APPROXIMATE OVERFLOW PROFILE

2) THE OVERFLOW RATING CURVE CAN BE [illegible] BY THE [illegible]

$Q = 363\,H^{3/2} + 105\,(H - [illegible])^{3/2} + [illegible]\,(H - 3.7)^{3/2}$ [illegible]



# Cahn Engineers Inc. Consulting Engineers

Project ______ Sheet ______ of ______
Computed By ______ Checked By ______ Date ______
Field Book Ref. ______ Other Refs. ______ Revisions ______

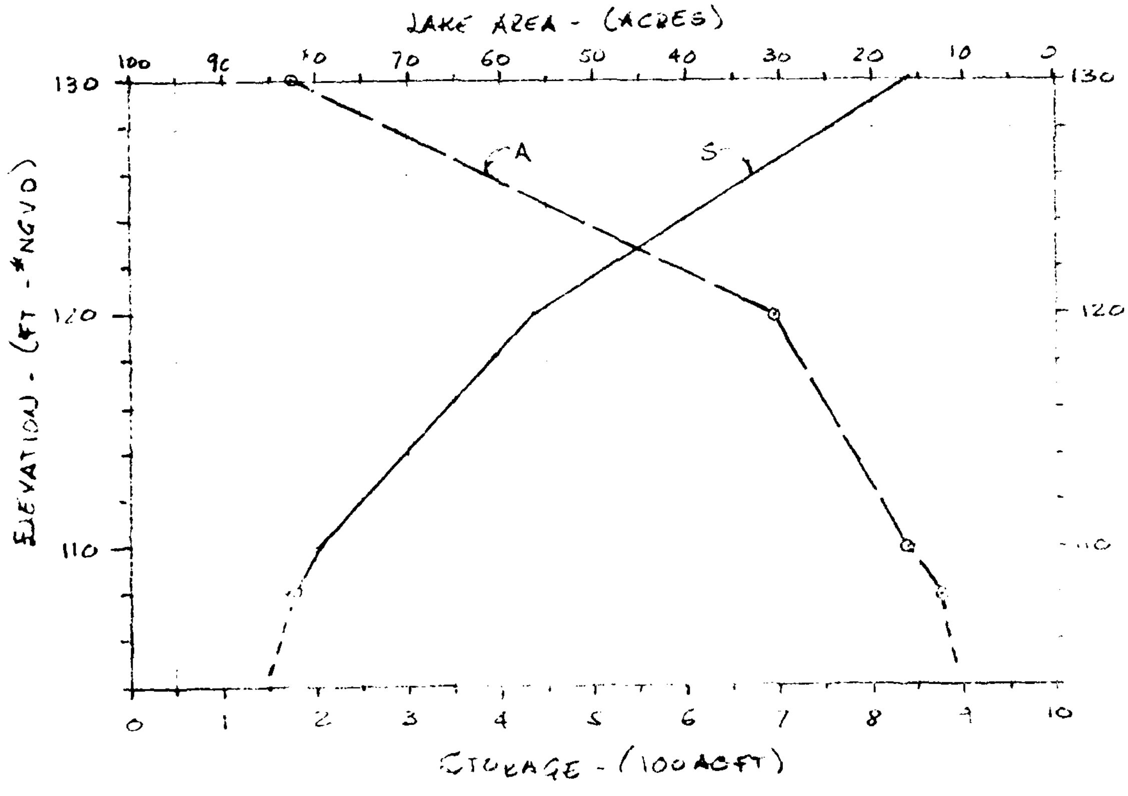
b) SURCHARGE DEPTHS TO PASS PEAK INFLOWS ($Q_{P_1}$ & $Q'_{P_1}$)

i) @ $Q_{P_1}$ = PMF = 33000 CFS     $H_1$ = [illegible]'

ii) @ $Q'_{P_1}$ = ½ PMF = 16500 CFS     $H'_1$ = [illegible]'

c) EFFECT OF SURCHARGE - PEAK OUTFLOWS.

i) LAKE AREA / STORAGE RATING CURVES - ARCTIC DAM




Ⓐ - DATA FROM R.I. DEPT. OF PUBLIC WORKS - DIV OF HARBORS & RIVERS - (TABULATION FOR DAM # 198)
ALSO ON ACE US. INVENTORY OF DAMS, - NORMAL STORAGE : S = 173 ACFT [illegible]
Ⓑ - AREAS MEASURED ON USGS CRANSTON, R.I. QUADRANGLE SHEET (REV. [illegible])
* SEE NOTE P. D-1

**Cahn Engineers Inc.** **Consulting Engineers**

Project: [illegible]    Sheet [illegible] of [illegible]
Computed By [illegible]    Checked By [illegible]    Date [illegible]
Field Book Ref    Other Refs [illegible]    Revisions

(i) WATERSHED D.A. ≈ 73.4 SQ.MI. (SEE [illegible])

(ii) PEAK OUTFLOWS ($Q_{P_3}$ & $Q'_{P_3}$)

BECAUSE THE LAKE AREA AND [illegible] OF ARCTIC DAM ARE TOO [illegible] IN THE REDUCTION OF THE PEAK INFLOW THE PEAK OUTFLOWS ARE APPROXIMATELY,

$$Q_{P_3} \approx Q_{P_1} = 33000^{CFS} \qquad H_3 \approx \underline{16.0'}$$

$$Q'_{P_3} \approx Q'_{P_1} = 16500^{CFS} \qquad H'_3 \approx \underline{10.1'}$$

3) SPILLWAY CAPACITY RATIO TO PEAK OUTFLOWS

| SPILLWAY CAPACITY [illegible] | SURCH.* H (FT) | W.S. ELEV.† (FT NGVD) | SPILLWAY CAPACITY† (CFS) | SPILLWAY CAPACITY AS % OF PEAK OUTFLOWS | |
|---|---|---|---|---|---|
| | | | | $Q_{P_3}$ (33000 CFS) | $Q'_{P_3}$ (16500 CFS) |
| TOP OF DAM** | [illegible] | 111.3 | [illegible] | [illegible] | [illegible] |
| [illegible] | 10.1 | 118.1 | [illegible] | | [illegible] |
| PMF | 16.0 | [illegible] | [illegible] | [illegible] | |

* SURCHARGE ABOVE SPILLWAY [illegible]
** [illegible] DAM [illegible]
[illegible] NO [illegible] OF SPILLWAY [illegible]
[illegible] ELEV 105' NGVD [illegible]

ARCTIC DAM

II) DOWNSTREAM FAILURE HAZARD

1) POTENTIAL IMPACT AREA

TWO LARGE INDUSTRIAL BUILDINGS ARE LOCATED IN THE SOUTH BRANCH OF THE PAWTUXET RIVER (±)2500' AND (±)3700', RESPECTIVELY, D/S FROM ARCTIC DAM. TWO OTHER DAMS (RI #147 AND #146) LOCATED NEAR THESE BUILDINGS, IMPOUND WATER TO NORMAL LEVELS (±)15' BELOW THE FIRST FLOORS OF THE BUILDINGS' SECTIONS ON THE U/S SIDE OF THESE RESERVOIRS. THE BUILDINGS' SECTIONS D/S FROM THE DAMS, ARE (±)7' AND 11' RESPECTIVELY, ABOVE THE WATER LEVEL OF RES #146 AND THE RIVER CHANNEL D/S FROM THE DAMS. THESE STRUCTURES CONSTITUTE THE POTENTIAL IMPACT AREA IN CASE OF FAILURE OF ARCTIC DAM.

2) FAILURE AT ARCTIC DAM

ASSUME SURCHARGE TO TOP OF DAM, ELEV. 111.3' NGVD

a) HEIGHT OF DAM* $H_{max} = 30'$, TOE OF DAM @ [illegible] ABUTMENT* ELEV. 85.2' NGVD
[illegible] ASSUME STREAMBED @ D/S FACE (*) ELEV. 82' NGVD ∴ $H = 111.7 - 82 = 30'$ [illegible]

b) MID HEIGHT LENGTH* : $\ell_{\frac{1}{2}} = 155'$

c) BREACH WIDTH (SEE NED-ACE D/S DAM FAILURE GUIDELINES)

$W = 0.4 \times 155 = 62'$ . ASSUME $W_b = \underline{\underline{62'}}$

d) ASSUMED WATER DEPTH AT TIME OF FAILURE: $Y_0 = \underline{\underline{29.3'}}$ (TO FIRST 4 OF [illegible] TOPPING EL. 111.3' [illegible])

e) SPILLWAY DISCHARGE AT TIME OF FAILURE:

(i) PREVIOUS TO FAILURE [illegible] (SEE P. D-4)
(ii) AFTER FAILURE (ASSUMED REMAINING SPILL. L = 70'); [illegible] 1200 [illegible]

*FROM CE MEASUREMENTS ON 10/18/80 BY [illegible], [illegible] & F.S.

# Cahn Engineers Inc. Consulting Engineers

Project: Non Federal Dam Inspections Sheet: [illegible]
Computed By: [illegible] Checked By: [illegible] Date: [illegible]
Field Book Ref: Other Refs: CEF [illegible]-783 Revisions:

2) BREACH OUTFLOW (SEE NED-ACE GUIDELINES)

$Q_b = \frac{8}{27} W_b \sqrt{g}\, Y_0^{3/2} = 16500$ CFS

3) PEAK FAILURE OUTFLOW ($Q_p$) TO S. BRANCH PAWTUCKET RIVER

$Q_p = Q_s + Q_b = \underline{18300}$ CFS

3) FLOOD DEPTH* IMMEDIATELY D/S FROM DAM

$Y = 0.44\, Y_0 = \underline{\underline{12.9'}}$

*(FROM RETREATING WAVE THEORY APPLIED TO DAM FAILURE)

4) ESTIMATE OF D/S FAILURE CONDITIONS AT POTENTIAL IMPACT AREA.

(SEE NED-ACE GUIDELINES FOR ESTIMATING D/S FAILURE HYDROGRAPH)

a) THE W.S. IN THE [illegible] LONG REACH OF S. BR. PAWTUCKET RIVER D/S FROM THE DAM TO THE POTENTIAL IMPACT AREA IS CONTROLLED BY THIS DAM [illegible] RT 117 & FIRST [illegible] AT DAM #[illegible] (UPPER RIVER) [illegible]
A [illegible] 25' [illegible] [illegible] [illegible]
THE [illegible] 2000' [illegible] [illegible]
AT [illegible] [illegible]
[illegible]
[illegible]
[illegible] 200' [illegible]
WIDE [illegible] AND EXTENDS [illegible] TO THE [illegible] DAM [illegible]

b) RESERVOIR STORAGE AT TIME OF FAILURE

$S_{MAX} = 3[illegible]$ AC-FT [illegible]

*DATA FROM [illegible] [illegible]
[illegible]

**Cahn Engineers Inc.** Consulting Engineers

Project NON FEDERAL DAMS INSPECTION Sheet D-? of ??
Computed By HW Checked By ?? Date ??
Field Book Ref Other Refs. CE #27-?? Revisions

2) APPROXIMATE STAGE AT POTENTIAL DAMAGE AREA AFTER FAILURE

i) 1ST REACH D/S FROM K.J. DAM #147

ROUGH OVERFLOW APPROX. EQUAL TO ?? AND C ≈ 3.0
ASSUME AVE LAKE AREA (A) WITHIN THE EXPECTED MAX. ?? (≈13'), EQUAL
TO: $\bar{A} \approx 140 \times 2500 = 350000^{SQ\,FT} \approx 8^{AC}$

THE TOTAL OVERFLOW FROM K.J. DAM #147 IS APPROXIMATED BY

$$Q_{(147)} \approx 384 H^{3/2}$$

AND, APPROXIMATE ROUTING (SEE NED-ACE GUIDELINES) OF THE PEAK FAILURE OUTFLOW GIVES

$$(Q_{p_3})_1 \approx Q_{p_1}\left(1 - \frac{V_3}{S}\right) \approx \underline{12000}^{CFS} \quad ; \quad (H_3)_1 \approx 9.9' \text{ (D/S KJ DAM \#147)}$$

ii) 2ND REACH D/S FROM K.J. DAM #146

ASSUME C = 3.2 AND C = 2.8 FOR THE SPILLWAY FLOW AND DAM ADJACENT TERRAIN OVERFLOW. -
ASSUME AVE LAKE AREA ($\bar{A}$) WITHIN THE EXPECTED SURCHARGE
$\bar{A} \approx 150 \times 1400 = 210000^{SQ\,FT} \approx \underline{4.8}^{AC}$

THE TOTAL OVERFLOW FROM K.J. DAM #146 IS APPROXIMATED BY

$$Q_{(146)} \approx 320 H^{3/2} + ??? (H-5)^{3/2}$$

APPROXIMATE ROUTING OF THE PEAK OUTFLOW ($(Q_p)_1 = 12000^{CFS}$) GIVES:

$$(Q_{p_3})_2 \approx \underline{1800}^{CFS} \qquad (H_3)_2 \approx \underline{5.?}' \text{ (D/S KJ DAM \#146)}$$

ahn Engineers Inc. Consulting Engineers

Pred By ___ Checked By ___ Date ___
Book Ref ___ Other Refs ___ Revisions ___

1) APPROXIMATE STAGE BEFORE FAILURE

i) 1ST REACH $H_{1} \approx 3.0'$

ii) 2ND REACH

2) RAISE IN STAGE H/C FROM DAM

i) 1ST REACH $(\Delta H)_1 \approx 6.7'$

ii) 2ND REACH: $(\Delta H)_2 \approx 5.1'$

**ahn Engineers Inc.** Consulting Engineers

ct NON-FEDERAL DAMS INSPECTION Sheet D-1 of
...ated By [illegible] Checked By [illegible] Date [illegible]
Book Ref. Other Refs. CE #27-785-HB Revisions

ARCTIC DAM

III) SELECTION OF TEST FLOOD

1) CLASSIFICATION OF DAM ACCORDING TO NED-ACE GUIDELINES

a) SIZE: *STORAGE (MAX) ≅ 330 AC-FT (50 < S < 1000 AC-FT)
*HEIGHT ≅ 33' (25 < H < 40 FT)

*STORAGE SEE p. D-3; HEIGHT SEE p. D-5

∴ SIZE CLASSIFICATION: SMALL

b) HAZARD POTENTIAL: AS A RESULT OF THE D/S FAILURE ANALYSIS AND IN VIEW OF THE IMPACT THAT FAILURE OF ARCTIC DAM MAY HAVE ON THE POTENTIAL IMPACT AREA (p. D-5), THE DAM IS CLASSIFIED AS HAVING:

HAZARD CLASSIFICATION: HIGH

2) TEST FLOOD: 1/2 PMF = 16500 CFS

THIS SELECTION IS BASED ON THE RESULTS OF THE PREVIOUS ANALYSIS AND CLASSIFICATION

ARCTIC DAM

III) SUMMARY

1) TEST FLOOD: ½ PMF = 16500 CFS
(... ARE ALSO SUMMARIZED BELOW)

2) PERFORMANCE AT PEAK FLOOD CONDITIONS

a) PEAK INFLOWS: $Q_p$ PMF ≅ 33000 CFS  $Q_p'$ = ½ PMF = 16500 CFS
b) PEAK OUTFLOWS $Q_3 ≅ Q_p$ = 33000 CFS  $Q_3' ≅ Q_p'$ = 16500 CFS
c) SPILLWAY CAPACITY (SEE TABLE p. D-4)
d) PERFORMANCE
(i) AT TEST FLOOD: OVERTOPPED (±) 7.6' (W.S. ELEV. ...)
(ii) AT PMF. OVERTOPPED (±) 13.5' (W.S. ELEV ...)

3) DOWNSTREAM FAILURE CONDITIONS:

a) PEAK FAILURE OUTFLOW $Q_p$ = 18500 CFS
... FROM DAM ...
c) CONDITIONS ... FROM ...
(i) STAGE BEFORE FAILURE ...
(ii) STAGE AFTER FAILURE $H_3$ ≅ ...
(iii) RAISE IN STAGE AFTER FAILURE: ΔH ≅ ...
d) CONDITIONS ... FROM ... DAM #146
(i) STAGE BEFORE FAILURE $H_2$ ≅ 3.6' ABOVE NORMAL POOL (... CFS)
(ii) STAGE AFTER FAILURE $H_3$ ≅ 8.7' ABOVE NORMAL POOL (...)
(iii) RAISE IN STAGE AFTER FAILURE ΔH ≅ 5.1'

# PRELIMINARY GUIDANCE

# FOR ESTIMATING

# MAXIMUM PROBABLE DISCHARGES

# IN

# PHASE I DAM SAFETY

# INVESTIGATIONS

New England Division
Corps of Engineers

March 1978

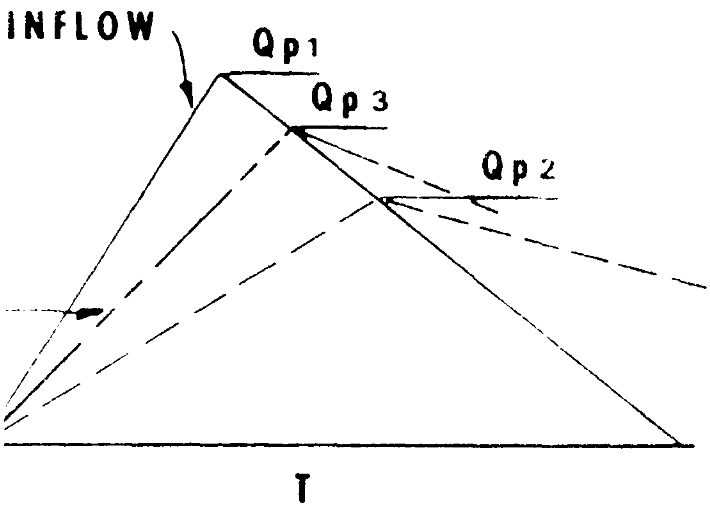
MAXIMUM PROBABLE FLOOD INFLOWS
NED RESERVOIRS

| | Project | Q (cfs) | D.A. (sq. mi.) | MPF cfs/sq. mi. |
|---|---|---|---|---|
| 1. | Hall Meadow Brook | 26,600 | 17.2 | 1,546 |
| 2. | East Branch | 15,500 | 9.25 | 1,675 |
| 3. | Thomaston | 158,000 | 97.2 | 1,625 |
| 4. | Northfield Brook | 9,000 | 5.7 | 1,580 |
| 5. | Black Rock | 35,000 | 20.4 | 1,715 |
| 6. | Hancock Brook | 20,700 | 12.0 | 1,725 |
| 7. | Hop Brook | 26,400 | 16.4 | 1,610 |
| 8. | Tully | 47,000 | 50.0 | 940 |
| 9. | Barre Falls | 61,000 | 55.0 | 1,109 |
| 10. | Conant Brook | 11,900 | 7.8 | 1,525 |
| 11. | Knightville | 160,000 | 162.0 | 987 |
| 12. | Littleville | 98,000 | 52.3 | 1,870 |
| 13. | Colebrook River | 165,000 | 118.0 | 1,400 |
| 14. | Mad River | 30,000 | 18.2 | 1,650 |
| 15. | Sucker Brook | 6,500 | 3.43 | 1,895 |
| 16. | Union Village | 110,000 | 126.0 | 873 |
| 17. | North Hartland | 199,000 | 220.0 | 904 |
| 18. | North Springfield | 157,000 | 158.0 | 994 |
| 19. | Ball Mountain | 190,000 | 172.0 | 1,105 |
| 20. | Townshend | 228,000 | 106.0(278 total) | 820 |
| 21. | Surry Mountain | 63,000 | 100.0 | 630 |
| 22. | Otter Brook | 45,000 | 47.0 | 957 |
| 23. | Birch Hill | 88,500 | 175.0 | 505 |
| 24. | East Brimfield | 73,900 | 67.5 | 1,095 |
| 25. | Westville | 38,400 | 99.5(32 net) | 1,200 |
| 26. | West Thompson | 85,000 | 173.5(74 net) | 1,150 |
| 27. | Hodges Village | 35,600 | 31.1 | 1,145 |
| 28. | Buffumville | 36,500 | 26.5 | 1,377 |
| 29. | Mansfield Hollow | 125,000 | 159.0 | 786 |
| 30. | West Hill | 26,000 | 28.0 | 928 |
| 31. | Franklin Falls | 210,000 | 1000.0 | 210 |
| 32. | Blackwater | 66,500 | 128.0 | 520 |
| 33. | Hopkinton | 135,000 | 426.0 | 316 |
| 34. | Everett | 68,000 | 64.0 | 1,062 |
| 35. | MacDowell | 36,300 | 44.0 | 825 |

MAXIMUM PROBABLE FLOWS
BASED ON TWICE THE
STANDARD PROJECT FLOOD
(Flat and Coastal Areas)

| | River | SPF (cfs) | D.A. (sq. mi.) | MPF (cfs/sq. mi.) |
|---|---|---|---|---|
| 1. | Pawtuxet River | 19,000 | 200 | 190 |
| 2. | Mill River (R.I.) | 8,500 | 34 | 500 |
| 3. | Peters River (R.I.) | 3,200 | 13 | 490 |
| 4. | Kettle Brook | 8,000 | 30 | 530 |
| 5. | Sudbury River. | 11,700 | 86 | 270 |
| 6. | Indian Brook (Hopk.) | 1,000 | 5.9 | 340 |
| 7. | Charles River. | 6,000 | 184 | 65 |
| 8. | Blackstone River. | 43,000 | 416 | 200 |
| 9. | Quinebaug River | 55,000 | 331 | 330 |

## TIMATING EFFECT OF SURCHARGE STORAGE ON MAXIMUM PROBABLE DISCHARGES




1: Determine Peak Inflow ($Q_{p1}$) from Guide Curves.

2: a. Determine Surcharge Height To Pass "$Q_{p1}$".

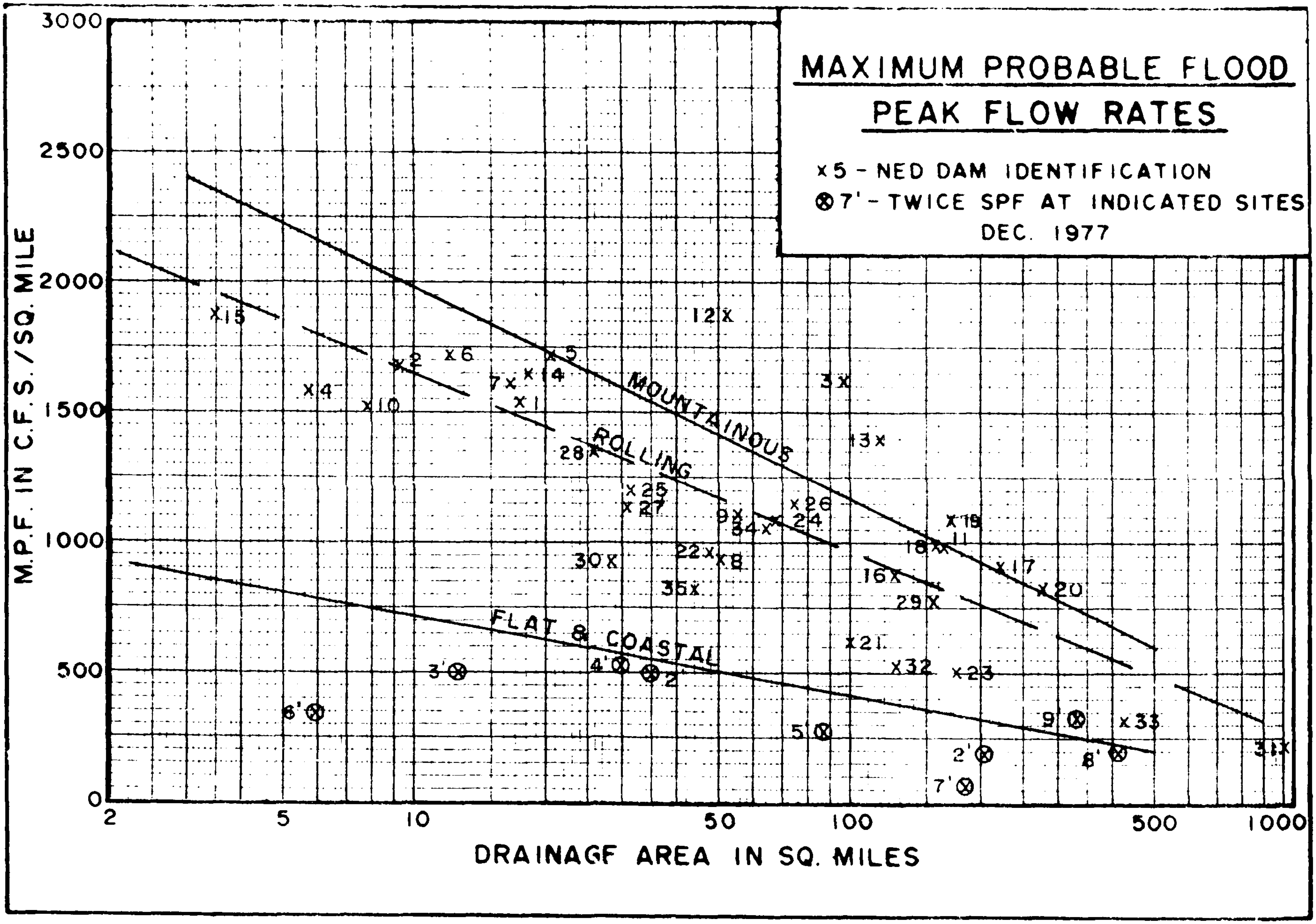
   b. Determine Volume of Surcharge ($STOR_1$) In Inches of Runoff.

   c. Maximum Probable Flood Runoff In New England equals Approx. 19", Therefore:

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR_1}{19}\right)$$

3: a. Determine Surcharge Height and "$STOR_2$" To Pass "$Q_{p2}$"

   b. Average "$STOR_1$" and "$STOR_2$" and Determine Average Surcharge and Resulting Peak Outflow "$Q_{p3}$".


MAXIMUM PROBABLE FLOOD
PEAK FLOW RATES
x5 - NED DAM IDENTIFICATION
⊗7' - TWICE SPF AT INDICATED SITES
DEC. 1977
MOUNTAINOUS
ROLLING
FLAT & COASTAL
M.P.F. IN C.F.S./SQ. MILE
DRAINAGF AREA IN SQ. MILES
3000
2500
2000
1500
1000
500
0
2
5
10
50
100
500
1000

# SURCHARGE STORAGE ROUTING SUPPLEMENT

STEP 3: a. Determine Surcharge Height and "$STOR_2$" To Pass "$Qp_2$"

b. Avg "$STOR_1$" and "$STOR_2$" and Compute "$Qp_3$".

c. If Surcharge Height for $Qp_3$ and "$STOR_{AVG}$" agree O.K. If Not:

STEP 4: a. Determine Surcharge Height and "$STOR_3$" To Pass "$Qp_3$"

b. Avg. "Old $STOR_{AVG}$" and "$STOR_3$" and Compute "$Qp_4$"

c. Surcharge Height for $Qp_4$ and "New $STOR_{Avg}$" should Agree closely

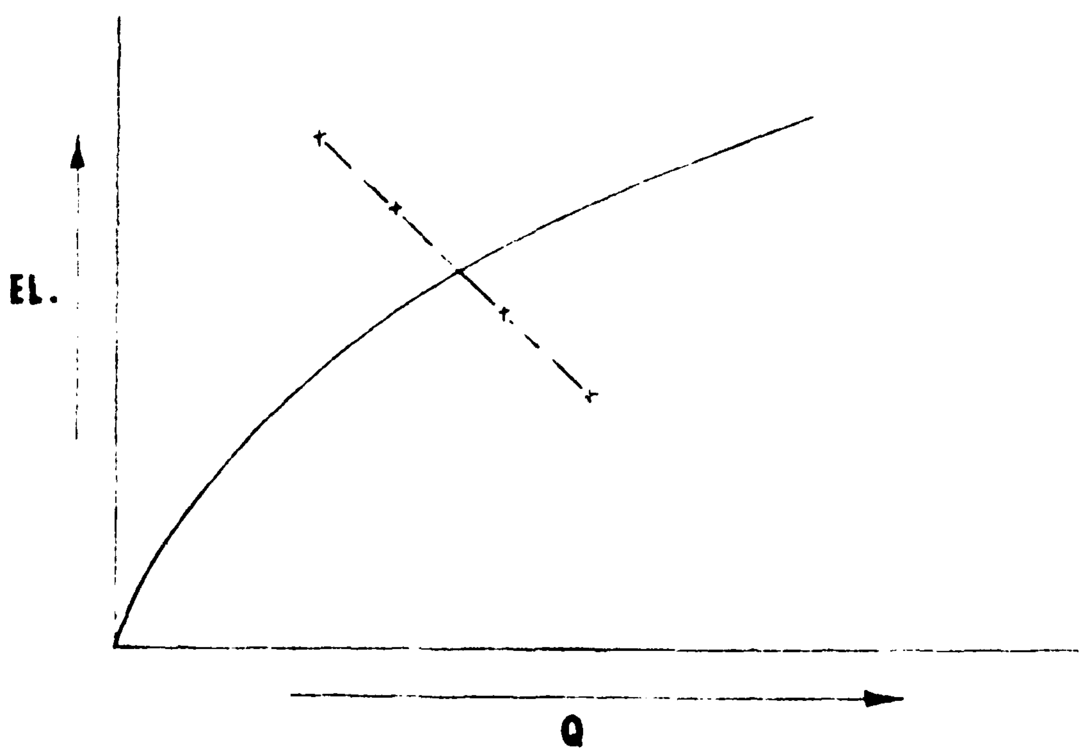
# SURCHARGE STORAGE ROUTING ALTERNATE

$$Q_{p2} = Q_{p1} \times \left(1 - \frac{STOR}{19}\right)$$

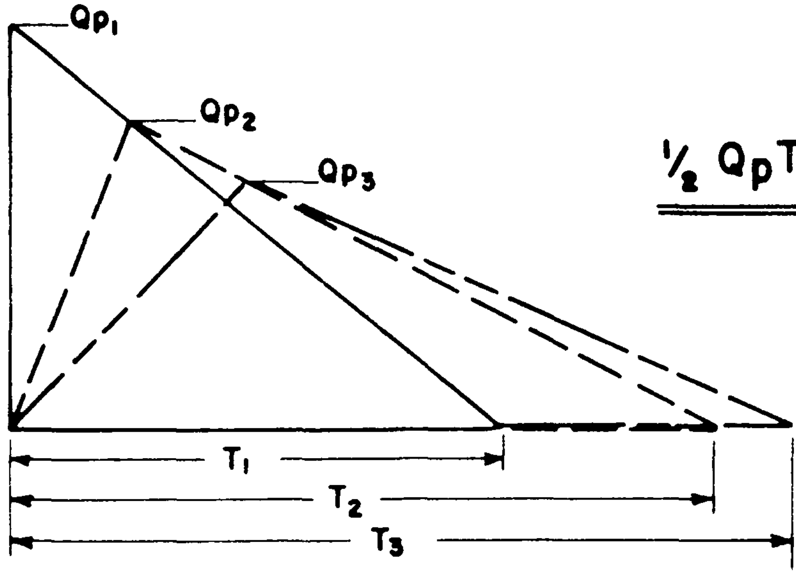
$$Q_{p2} = Q_{p1} - Q_{p1}\left(\frac{STOR}{19}\right)$$

FOR KNOWN $Q_{p1}$ AND 19'' R.O.

| $Q_{p2}$ | STOR | EL. |
|---|---|---|
| | | |
| | | |
| | | |
| | | |



# "RULE OF THUMB" GUIDANCE FOR ESTIMATING DOWNSTREAM DAM FAILURE HYDROGRAPHS




$\frac{1}{2} Q_p T = 12\ S$

**STEP 1:** DETERMINE OR ESTIMATE RESERVOIR STORAGE (S) IN AC-FT AT TIME OF FAILURE.

**STEP 2:** DETERMINE PEAK FAILURE OUTFLOW ($Q_{p1}$).

$$Qp_1 = \frac{8}{27} W_b \sqrt{g}\ Y_o^{3/2}$$

$W_b$ = BREACH WIDTH - SUGGEST VALUE NOT GREATER THAN 40% OF DAM LENGTH ACROSS RIVER AT MID HEIGHT.

$Y_o$ = TOTAL HEIGHT FROM RIVER BED TO POOL LEVEL AT FAILURE.

**STEP 3:** USING USGS TOPO OR OTHER DATA, DEVELOP REPRESENTATIVE STAGE-DISCHARGE RATING FOR SELECTED DOWNSTREAM RIVER REACH.

**STEP 4:** ESTIMATE REACH OUTFLOW ($Q_{p2}$) USING FOLLOWING ITERATION.

A. APPLY $Q_{p1}$ TO STAGE RATING, DETERMINE STAGE AND ACCOPMANYING VOLUME ($V_1$) IN REACH IN AC-FT. (NOTE: IF $V_1$ EXCEEDS 1/2 OF S, SELECT SHORTER REACH.)

B. DETERMINE TRIAL $Q_{p2}$.

$$Qp_2(\text{TRIAL}) = Qp_1 \left(1 - \frac{V_1}{S}\right)$$

C. COMPUTE $V_2$ USING $Q_{p2}$ (TRIAL).

D. AVERAGE $V_1$ AND $V_2$ AND COMPUTE $Q_{p2}$.

$$Qp_2 = Qp_1 \left(1 - \frac{V_{ave}}{S}\right)$$

**STEP 5:** FOR SUCCEEDING REACHES REPEAT STEPS 3 AND 4.

APRIL 1978

# APPENDIX E

## INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

# INVENTORY OF DAMS IN THE UNITED STATES

| STATE | IDENTITY NUMBER | DIVISION | STATE | COUNTY | CONGR. DIST. | STATE | COUNTY | CONGR. DIST. | NAME | LATITUDE (NORTH) | LONGITUDE (WEST) | REPORT DATE DAY MO YR |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| RI | 3802 | NED | RI | 003 | 02 | | | | ARCTIC DAM | 4142.4 | 7131.3 | 05FEB81 |

| POPULAR NAME | NAME OF IMPOUNDMENT |
|---|---|
| FACTORY STREET DAM | PAWTUXET RIVER-SOUTH BRANCH |

| REGION | BASIN | RIVER OR STREAM | NEAREST DOWNSTREAM CITY-TOWN-VILLAGE | DIST FROM DAM (MI.) | POPULATION |
|---|---|---|---|---|---|
| 01 | 09 | PAWTUXET RIVER-SOUTH BRANCH | WEST WARWICK | 0 | 24323 |

| TYPE OF DAM | YEAR COMPLETED | PURPOSES | STRUCTURAL HEIGHT (FT.) | HYDRAULIC HEIGHT (FT.) | IMPOUNDING CAPACITIES MAXIMUM (ACRE-FT.) | IMPOUNDING CAPACITIES NORMAL (ACRE-FT.) | DIST | OWN | FED R | PRV/FED | SCS A | VER/DATE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| OT | 1885 | O | 30 | 30 | 230 | 175 | NED | N | N | N | N | |

| REMARKS |
|---|
| 21 MASONRY AND EARTHFILL 23 INDUSTRIAL WATER |

| D/S HAS | SPILLWAY CREST LENGTH | SPILLWAY TYPE | SPILLWAY WIDTH (FT.) | MAXIMUM DISCHARGE (FT.) | VOLUME OF DAM (CY) | POWER CAPACITY INSTALLED (MW) | POWER CAPACITY PROPOSED (MW) | NO | NAVIGATION LOCKS LENGTH (FT.) | WIDTH (FT.) | LENGTH (FT.) | WIDTH (FT.) | LENGTH (FT.) | WIDTH (FT.) | LENGTH (FT.) | WIDTH (FT.) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | 174 | U | 110 | 2480 | | | | | | | | | | | | |

| OWNER | ENGINEERING BY | CONSTRUCTION BY |
|---|---|---|
| ARCTIC DEVELOPMENT CORP. | UNKNOWN | UNKNOWN |

| REGULATORY AGENCY DESIGN | CONSTRUCTION | OPERATION | MAINTENANCE |
|---|---|---|---|
| NONE | NONE | RI DEM | RI DEM |

| INSPECTION BY | INSPECTION DATE DAY MO YR | AUTHORITY FOR INSPECTION |
|---|---|---|
| CAHN ENGINEERS INC | 08OCT80 | PL 92-367 |

| REMARKS |
|---|
| |

END

FILMED

8-85

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